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1802 f. 90

THE

ART AND PRACTICAL APPLICATION

OF

ARITHMETIC

BY JOHN & THOMAS FLINT

NEW EDITION

GLASGOW
DAVID ROBERTSON, ST VINCENT STREET.
EDINBURGH: OLIVER AND BOYD. LONDON: HOULSTON AND WRIGHT.
MDCCCLXII.

1862

[illegible] 5.

"The surest way for a learner, in this as in all other cases, is not to advance by jumps and large strides; let that which he sets himself to learn next be indeed the next—that is, as nearly conjoined with what he knows already as is possible; let it be distinct, but not remote from it; let it be new, and what he did not know before, that the understanding may advance; *but let it be as little at once as may be, that its advances may be clear and sure. All the ground that it gets this way it will hold.* This distinct gradual growth in knowledge is firm and sure; it carries its own light with it, in every step of its progression, in an easy and orderly train, than which there is nothing of more use to the understanding. And though this, perhaps, may seem a very slow and lingering way to knowledge, yet I dare confidently affirm, that whoever will try it in himself, or any one he will teach, *shall find the advances greater in this method, than they would in the same space of time have been in any other he could have taken.* The greatest part of true knowledge lies in a distinct perception of things in themselves distinct. And some men give more clear light and knowledge by the bare distinct stating of a question, than others by talking of it in gross whole hours together. In this, they who so state a question, do no more but separate and disentangle the parts of it one from another, and lay them, when so disentangled, in their due order. This often, without any more ado, resolves the doubt, and shows the mind where the truth lies."

"Nobody is made any thing by hearing of rules, or laying them up in his memory; *practice* must settle the habit of doing *without reflecting on the rule."—Locke on the Conduct of the Understanding.*

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PREFACE.

Considering the primary object of all teaching to consist in preparing the pupil for the efficient discharge of those duties which are likely to devolve upon him in after life, and being convinced that, in the study ot Arithmetic, the Art, and its Practical Applications, in this point of view, are entitled to claim the highest position, and to demand the first consideration of the Arithmetician, either as such merely, or in the higher capacity of Teacher; and seeing that they have not received the share of attention which was due to them, owing chiefly to the exaggerated importance attached to the study of the Science, we have devoted ourselves entirely to the improvement of this branch of the subject, and the mode of teaching it. Accordingly, we have endeavoured to improve, in the first place, the Analysis of the Art, and to point out distinctly what are the *real elements*, to show the natural connection between them, and especially to indicate (principally, however, by example,) the perfect synthetical reconstruction, or the way by which the pupil may *most easily be led from one step to another*, until he is put in possession of the whole. We have also endeavoured to give *method*, and its proper place in the art of teaching to revision. The general principles which have guided us in the execution of this design are well expressed in the preceding quotations from Locke.

Nothing is so likely to produce in the Pupil's mind a permanent aversion to the study, as frequent failures; and there is nothing more likely to cause them, than a neglect of the fundamental principle of method, which consists in so graduating the exercises that the pupil is carried, without *unnecessary* trouble, by steps almost imperceptible, from what is undoubtedly the simplest, to that which is *sufficiently* difficult.

It is an essential principle, in the successful cultivation of every art, that the Pupil should ave acquired considerable facility in one exercise, before passing to another which is more difficult, and in none is its observance more necessary, or its neglect more prejudical, than in that of Arithmetic; for in it facility, in an advanced step, generally demands a corresponding facility in that which precedes it.

To secure the requisite facility, the exercises on each step of the art have been made very numerous.

Should any circumstance prevent a Teacher from affording his class the mental training involved in the Preparatory Exercises, he must remember that it is even more necessary in his case to adopt a system of slate exercises, which, like the following, should be numerous, and in which each set should form a distinct but easy step in the art; because the importance of such exercises is obviously enhanced by there being no previous mental preparation, all being made to depend upon them.

Our mode of presenting Reduction, Compound Addition, Compound Multiplication, and various other parts, on the principle of analysis, will be found to be an improvement in the art of teaching; but we think the 44th, 45th, 46th, 47th, 48th, and 49th pages should not be studied until after the 65th.

The process to which we have given the name of Compound Reduction is, we believe, very much used by business men, though in a somewhat less orderly form.

The last section of the 59th page, the first of the 60th, the first two of the 63d, and the whole of the 95th, will be found to be useful and methodical preparations for the calculation of Interest.

The 3d of the 63d page, the whole of the 72d, and the 1st half of the 73d, are very necessary preparations for Proportion. Proportion is the great difficulty of the practical art, and, at the same time the most important part of it; hence the analysis made of it at page 95. The answers to the Proportion are given down to the lowest denomination, as an exercise in Reduction and Division.

In conclusion, we beg leave to repeat, that we think the following Exercises will be found to be superior to those commonly given in elementary books, both in the analysis made of the subject, and in their nearer approach to the perfect synthetical progression, and, we may add, in the observance of method in the revisions.

In issuing a new edition of this work, it may be necessary for me to state that it was originally compiled by my late brother and myself for the use of our own pupils; and we have found that, without such a book, we could not have taught so efficiently in classes the large number of pupils which we have had under our care. The work has been found so essential, in the case of large classes especially, that I deemed it advisable to introduce the higher branches, so that the pupil might be furnished with a complete Arithmetical Text-Book. And if, after a trial, the additions made be found to be as useful as the first editions have proved, I have only to state, that to teachers having large numbers the book simply requires to be known to secure its introduction to general use. Most of the calculations have been thoroughly verified in the actual work of instruction; but any hints as to inaccuracies or defects will meet with careful consideration.

JOHN FLINT.

GLASGOW, *November*, 1861.

ARITHMETICAL EXERCISES.

COUNTING TABLE,

In which the digits are added, by construction, successively to every number between 1 and 100, in the form of continued additions of the same digit.

First Series by *One*.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22, &c. to 100

Second Series by *Two*.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
&c. to 100

Third Series by *Three*.

1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2 5 8 11 14 17 20 23 26 29 32 35 38 41 44 47 50 53
3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54
&c. to 100

Fourth Series by *Four*.

1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85 89
2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70 74 78 82 86 90
3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71 75 79 83 87 91
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92

Counting Table—*Continued.*

Fifth Series by *Five.*

1	6	11	16	21	26	31	36	41	46	51	56	61	66	71	76	81	86	91	96	101
2	7	12	17	22	27	32	37	42	47	52	57	62	67	72	77	82	87	92	97	102
3	8	13	18	23	28	33	38	43	48	53	58	63	68	73	78	83	88	93	98	103
4	9	14	19	24	29	34	39	44	49	54	59	64	69	74	79	84	89	94	99	104
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105

Sixth Series by *Six.*

1	7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97
2	8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98
3	9	15	21	27	33	39	45	51	57	63	69	75	81	87	93	99
4	10	16	22	28	34	40	46	52	58	64	70	76	82	88	94	100
5	11	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101
6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102

Seventh Series by *Seven.*

1	8	15	22	29	36	43	50	57	64	71	78	85	92	99
2	9	16	23	30	37	44	51	58	65	72	79	86	93	100
3	10	17	24	31	38	45	52	59	66	73	80	87	94	101
4	11	18	25	32	39	46	53	60	67	74	81	88	95	102
5	12	19	26	33	40	47	54	61	68	75	82	89	96	103
6	13	20	27	34	41	48	55	62	69	76	83	90	97	104
7	14	21	28	35	42	49	56	63	70	77	84	91	98	105

Eighth Series by *Eight.*

1	9	17	25	33	41	49	57	65	73	81
2	10	18	26	34	42	50	58	66	74	82
3	11	19	27	35	43	51	59	67	75	83
4	12	20	28	36	44	52	60	68	76	84
5	13	21	29	37	45	53	61	69	77	85
6	14	22	30	38	46	54	62	70	78	86
7	15	23	31	39	47	55	63	71	79	87
8	16	24	32	40	48	56	64	72	80	88

Ninth Series by *Nine.*

1	10	19	28	37	46	55	64	73	82	91
2	11	20	29	38	47	56	65	74	83	92
3	12	21	30	39	48	57	66	75	84	93
4	13	22	31	40	49	58	67	76	85	94
5	14	23	32	41	50	59	68	77	86	95
6	15	24	33	42	51	60	69	78	87	96
7	16	25	34	43	52	61	70	79	88	97
8	17	26	35	44	53	62	71	80	89	98
9	18	27	36	45	54	63	72	81	90	99

MULTIPLICATION TABLE, WITH SHILLINGS AND PENCE.

TWICE	3 TIMES	4 TIMES	5 TIMES	6 TIMES	7 TIMES	8 TIMES	9 TIMES	10 TIMES	11 TIMES	12 TIMES
L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L. s. d.
0 0 2 1 are 2	0 0 3 1 are 3	0 0 4 1 are 4	0 0 5 1 are 5	0 0 6 1 are 6	0 0 7 1 are 7	0 0 8 1 are 8	0 0 9 1 are 9	0 0 10 1 are 10	0 0 11 1 are 11	0 1 0 1 are 12
0 0 4 2 = 4	0 0 6 2 = 6	0 0 8 2 = 8	0 0 10 2 =10	0 1 0 2 =12	0 1 2 2 =14	0 1 4 2 =16	0 1 6 2 =18	0 1 8 2 =20	0 1 10 2 =22	0 2 0 2 =24
0 6 3 = 6	0 0 9 3 = 9	0 1 0 3 =12	0 1 3 3 =15	0 1 6 3 =18	0 1 9 3 =21	0 2 0 3 =24	0 2 3 3 =27	0 2 6 3 =30	0 2 9 3 =33	0 3 0 3 =36
0 0 8 4 = 8	0 1 0 4 =12	0 1 4 4 =16	0 1 8 4 =20	0 2 0 4 =24	0 2 4 4 =28	0 2 8 4 =32	0 3 0 4 =36	0 3 4 4 =40	0 3 8 4 =44	0 4 0 4 =48
0 0 10 5 10	0 1 3 5 =15	0 1 8 5 =20	0 2 1 5 =25	0 2 6 5 =30	0 2 11 5 =35	0 3 4 5 =40	0 3 9 5 =45	0 4 2 5 =50	0 4 7 5 =55	0 5 0 5 =60
0 1 0 6 =12	0 1 6 6 =18	0 2 0 6 =24	0 2 6 6 =30	0 3 0 6 =36	0 3 6 6 =42	0 4 0 6 =48	0 4 6 6 =54	0 5 0 6 =60	0 5 6 6 =66	0 6 0 6 =72
0 1 2 7 =14	0 1 9 7 =21	0 2 4 7 =28	0 2 11 7 =35	0 3 6 7 =42	0 4 1 7 =49	0 4 8 7 =56	0 5 3 7 =63	0 5 10 7 =70	0 6 5 7 =77	0 7 0 7 =84
0 1 4 8 =16	0 2 0 8 =24	0 2 8 8 =32	0 3 4 8 =40	0 4 0 8 =48	0 4 8 8 =56	0 5 4 8 =64	0 6 0 8 =72	0 6 8 8 =80	0 7 4 8 =88	0 8 0 8 =96
0 1 6 9 =18	0 2 3 9 =27	0 3 0 9 =36	0 3 9 9 =45	0 4 6 9 =54	0 5 3 9 =63	0 6 0 9 =72	0 6 9 9 =81	0 7 6 9 =90	0 8 3 9 =99	0 9 0 9 =108
0 1 8 10=20	0 2 6 10=30	0 3 4 10=40	0 4 2 10=50	0 5 0 10=60	0 5 10 10=70	0 6 8 10=30	0 7 6 10=90	0 8 4 10=100	0 9 2 10=110	0 10 0 10=120
0 1 10 11=22	0 2 9 11=33	0 3 8 11=44	0 4 7 11=55	0 5 6 11=66	0 6 5 11=77	0 7 4 11=88	0 8 3 11=99	0 9 2 11=110	0 10 1 11=121	0 11 0 11=132
0 2 0 12=24	0 3 0 12=36	0 4 0 12=48	0 5 0 12=60	0 6 0 12=72	0 7 0 12=84	0 8 0 12=96	0 9 0 12=108	0 10 0 12=120	0 11 0 12=132	0 12 0 12=144
0 2 2 13=26	0 3 3 13=39	0 4 4 13=52	0 5 5 13=65	0 6 6 13=78	0 7 7 13=91	0 8 8 13=104	0 9 9 13=117	0 10 10 13=130	0 11 11 13=143	0 13 0 13=156
0 2 4 14=28	0 3 6 14=42	0 4 8 14=56	0 5 10 14=70	0 7 0 14=84	0 8 2 14=98	0 9 4 14=112	0 10 6 14=126	0 11 8 14=140	0 12 10 14=154	0 14 0 14=168
0 2 6 15=30	0 3 9 15=45	0 5 0 15=60	0 6 3 15=75	0 7 6 15=90	0 8 9 15=105	0 10 0 15=120	0 11 3 15=135	0 12 6 15=150	0 13 9 15=165	0 15 0 15=180
0 2 8 16=32	0 4 0 16=48	0 5 4 16=64	0 6 8 16=80	0 8 0 16=96	0 9 4 16=112	0 10 8 16=128	0 12 0 16=144	0 13 4 16=160	0 14 8 16=176	0 16 0 16=192
0 2 10 17=34	0 4 3 17=51	0 5 8 17=68	0 7 1 17=85	0 8 6 17=102	0 9 11 17=119	0 11 4 17=136	0 12 9 17=153	0 14 2 17=170	0 15 7 17=187	0 17 0 17=204
0 3 0 18=36	0 4 6 18=54	0 6 0 18=72	0 7 6 18=90	0 9 0 18=108	0 10 6 18=126	0 12 0 18=144	0 13 6 18=162	0 15 0 18=180	0 16 6 18=198	0 18 0 18=216
0 3 2 19=38	0 4 9 19=57	0 6 4 19=76	0 7 11 19=95	0 9 6 19=114	0 11 1 19=133	0 12 8 19=152	0 14 3 19=171	0 15 10 19=190	0 17 5 19=209	0 19 0 19=228
0 3 4 20=40	0 5 0 20=60	0 6 8 20=80	0 8 4 20=100	0 10 0 20=120	0 11 8 20=140	0 13 4 20=160	0 15 0 20=180	0 16 8 20=200	0 18 4 20=220	1 0 0 20=240

FIRST PREPARATORY EXERCISE—PART FIRST.*

The Digits added to the Digits.

The first Exercise on the following arrangements consists in adding the nine digits successively in their natural order, 1, 2, 3, &c., to every digit in each of the arrangements.†

THE FIRST ARRANGEMENTS OF THE DIGITS.

10. 9 4 7 6 3 1 8 2 5	6. 4 8 9 7 1 5 2 3 6	2. 7 9 8 3 1 2 4 5 6
9. 4 9 6 7 3 1 8 5 2	5. 1 2 5 6 9 8 4 3 7	1. 1 2 4 6 9 7 3 8 5
8. 4 2 9 5 6 8 7 1 3	4. 7 3 4 8 9 6 5 2 1	0. 5 8 7 6 3 9 4 2 1
7. 3 1 7 8 6 5 9 4 2	3. 2 1 5 9 6 7 4 3 8	5. 6 3 2 5 1 7 9 8 4

OR (ABRIDGED) ADD

1 2 3 4 5 6 7 8 and 9 successively to the numbers 1 4 0 3 6 2 8 7 5 9, and name the results only.

---

* The pupil's progress will be comparatively rapid if the Teacher be successful in preventing him from falling into the bad habits of counting his fingers in addition, learning the multiplication table by rote, and putting down the carriage in the slate additions and multiplications. Now this will be most effectually done if the Teacher has leisure to hear him say aloud the Preparatory Exercises which precede each of the Simple Rules, as he will thus have an opportunity of giving him that assistance which alone will render *unnecessary*, and thus prevent his having recourse to such helps.

† The pupils must be required, in this and every succeeding Exercise, to name at each step the result only; and in the case of the Elementary Combinations, in which there are necessarily more than one result, the pupil must name only the *last*. For example, in the above Exercise, in adding one to the first arrangement, beginning at the right hand, instead of saying 5 and 1 are 6, 2 and 1 are 3, 8 and 1 are 9, &c., say 6, 3, 9, &c.; and, in like manner, in adding 5 to the numbers of the last row, simply say 9, 13, 14, 12, 6, 10, 7, 8, 11.

This Exercise is the foundation on which is built the whole fabric of the mental processes of the art, consequently the degree of ease with which the young pupil will acquire these processes will depend in a very great measure on the facility he has acquired in this Exercise.

To be written and added on the slate.

1
2222
4325

2
2222
7186

3
3333
5294

4
3333
8376

5
4444
2635

6
5555
5634

7
4444
4958

8
2468
5555

9
4352
6666

10
1342
7777

11
4355
6776

12
3719
4554

13
7928
3243

14
6988
4138

15
103
317

16
211
935

17
425
479

18
3716
3947

19
3451
7899

20
4054
9274

21
3103
5647

22
4210
8396

23
6025
6479

24
5726
4938

25
8751
6989

26
9274
4054

27
6143
3971

28
156869
78676

29
952487
859546

30
1354573
736854

31
1354573
745669

32
1543876
987325

33
1454219
867654

34
765234
219837

35
1347321
454219

36
1454219
867654

37
1432594
867654

38
1457683
798468

39
837875
597456

40
735487
129345

41
648372
192761

42
429342
217537

43
976874
578675

44
1645793
845948

45
754536
378645

46
1548834
764379

47
899423
273596

48
893594
548668

49
754869
684321

50
913782
456359

51
987214
768435

52
987654
279867

53
546798
314657

54
979546
253785

55
647891
346287

56
376389
247721

57
486742
247684

58
764325
438976

59
274389
156927

60
576842
207513

61
256117
184575

62
368197
352051

63
576348
297651

64
789218
127317

65
867829
276351

66	69	72	75	78
789256	632597	546391	9854216	8671432
145825	325973	456549	2876432	2341768
67	70	73	76	79
628157	926843	6875467	8457867	8703482
5236	843629	3457893	2973965	4832978
68	71	74	77	80
268543	421784	8476321	8457867	7632895
200701	387124	3651978	5894317	2487146

Note 1.—The ease with which the pupil will perform the above will be in proportion to the facility he has acquired in the preceding *Preparatory Exercise.* And we may observe here, once for all, that the same remark equally applies to every succeeding page, in reference to its Preparatory Exercise.

First Preparatory Exercise.—*Part Second.*

(*Ten and the digits added to the digits*).

Consists in first adding 10 to every number in each row, at page 8, and then the digit as in the first part: thus, instead of adding 7 to 4, 2, 9, 5, 6, 8, 7, 1, 3, the numbers of the row, under 8, the pupil is to add 7 to 14, 12, 19, 15, 16, 18, 17, 11, 13; or (abridged) add the numbers 3, 5, 2, 6, 4, 9, 7, 8, successively and rapidly, to the numbers 11, 14, 10, 13, 16, 12, 18, 17, 15, 19, and name the results only.

ADDITION (+) EXERCISES.

To be written and added on the slate, and to be proved afterwards by subtracting the three lines of each from the respective Answer.

81	84	87	90	93	96	99	102
222	333	444	555	363	666	456	657
431	354	345	415	324	523	456	345
534	234	551	345	432	844	567	678
82	85	88	91	94	97	100	103
333	444	555	543	464	736	647	767
213	513	234	453	333	234	476	534
452	242	545	354	545	345	678	789
83	86	89	92	95	98	101	104
333	444	555	262	566	654	765	678
243	543	423	213	454	453	674	721
532	343	454	345	532	456	678	789

105
7689
2222
4437

106
3867
3333
1436

107
6249
4444
4014

108
5555
2222
1347

109
4976
3323
3333

110
7368
4343
4444

111
6132
5454
4445

112
7894
5555
7530

113
10000
6666
8273

114
9999
6666
5879

115
88888
55555
45697

116
77777
44444
51328

117
66666
33333
26798

118
72934
65656
55556

119
74382
56565
66167

120
82064
67777
77778

121
68374
34554
88889

122
57163
77777
78186

123
49678
67765
84513

124
91476
67567
28347

125
621372
888888
239341

126
768349
787878
341379

127
567842
678876
146913

128
876354
999999
347987

129
531276
989898
283178

130
756834
434343
899889

131
796285
678998
234567

132
826697
789967
667898

133
876483
429654
222222

134
597861
987654
333333

135
896348
486677
444444

136
800401
511405
555555

137
334455
765469
666666

138
667788
845899
777777

139
640392
579639
888888

140
541306
873495
999999

141
945178
766689
665566

142
776668
845798
576576

143
576870
897684
767676

144
953407
478539
687688

145
7591348
1437892
6798987

146
6341076
3417892
9877897

147
2956714
1604802
6439152

148
3020104
4567918
1369400

149
5431040
1163476
7832658

150
4187215
6809309
4700315

151
6504083
1904177
6654832

152
3832401
7796847
4451302

153
7968425
3112345
5779876

154
7989758
6543217
8987976

Second Preparatory Exercise.—*Part First.*

To say what number, added to the less of two small numbers, will make it equal to the greater.

Say what number, added to the digits of each arrangement, at page 8, will make each digit equal to the small number which stands above the arrangement, previously adding ten to the number above when it is less than that of the row: thus, taking the row under 8, the pupil is to say what number added to 3 will make 8, what number added to 1 will make 8, what added to 7 will make 8, what added to 8 will make 8, what added to 6 and to 5 will make 8, what added to 9 will make 18, &c., simply saying 5—7—1—0—2—3—9—6—4.

Second Preparatory Exercise.—*Part Second.*

Say what number, added to the small number above each row, will make it equal to each digit in the row, previously adding 10 to the digit when it is less than the small number above. Take the row under 3, (page 8,) the exercise is to say what number added to 3 will make 8—3—4—7—6—9—5—11—12—(10 is added to the two last, because they were less than 3)—and the answers, of course, are 5—0—1—4—3—6—2—8—9.

1
57689
34437

2
73867
51436

3
76249
24014

4
67894
17530

5
100000
82734

6
100000
61253

7
99999
45879

8
88888
45697

9
77777
51328

10
66666
26798

11
55555
21347

12
44444
41796

13
33333
17594

14
22222
17658

15
11111
4213

16
34976
33333

17
47368
14444

18
30132
24445

19
572934
355556

20
674382
566167

21
432064
177778

22
568374
188889

23
457163
178186

24
349678
184513

25
291476
128347

26
621372
239341

27
768349
341378

28
567842
146913

29
876354
347987

30
531276
283178

31
49876483
41429654

32
34597861
29987654

33
79634801
48667734

34
80040127
51140549

35
22334455
8765469

36	39	42	45	48
55667788	83945178	89534071	2956714	5431040
16845899	77766689	34785395	1604802	1163476
37	40	43	46	49
76403981	77766688	7591348	6439152	832658
45796329	38457948	1437892	3020104	418215
38	41	44	47	50
75413086	34576820	6341076	4567918	6800309
48734915	17897684	3417892	1369400	4700315

SIMPLE ADDITION.

First Preparatory Exercise.—*Part Third.*

To every number in each of the following horizontal rows add the nine digits successively in their natural order—1, 2, 3, 4, &c.

10	80	30	60	50	40	70	20	90
11	81	81	61	51	41	71	21	91
92	22	72	42	52	62	32	82	12
83	63	43	23	93	73	53	33	13
94	64	14	34	54	84	74	24	44
15	85	35	65	55	45	75	25	95
16	56	26	46	96	66	36	86	76
17	27	97	77	87	67	57	37	47
78	48	98	38	18	68	88	58	28
19	89	39	69	59	49	79	29	99

Note.—The pupil's slate being ruled like the above, let him be instructed to write in the empty spaces, *first*, the numbers which are *two* more than each of the above, then those which are *three* more, next those that are *four* more, and so on; abridging, however, the Exercise in the case of the additives 2, 3, 4, and 5; but only in their case. And after he has shown, by the ease with which he does the Exercise, that he perceives the principle involved in its construction, he is then to learn to count by 6, 7, 8, 9, as in the Counting Table, writing the Exercise as he did the above. If the teacher has time to hear the pupil say this Exercise aloud, it will be much better than to cause him to write it as above directed.

Slate Addition Exercises.

1	2	3	4	5	6	7	8
222	333	332	444	444	434	565	565
435	534	451	234	342	234	348	354
333	441	444	555	555	545	338	423
541	654	534	314	425	345	455	546
456	546	423	453	354	453	444	444

9	10	11	12	13	14	15	16
222	333	444	555	234	345	456	456
343	434	451	423	163	123	214	712
345	234	215	325	214	234	352	223
333	444	433	344	453	555	454	555
173	374	457	751	726	757	777	777

17	18	19	20	21	22	23	24
232	343	454	565	244	355	466	466
333	342	555	314	523	354	345	153
443	344	432	457	754	323	213	654
343	454	565	244	355	466	466	565
275	575	475	551	257	467	723	743

25	26	27	28	29	30	31	32
234	345	453	456	564	567	567	567
463	364	465	131	666	343	444	311
356	654	564	666	312	666	777	777
571	457	472	335	425	777	342	666
435	542	456	777	777	454	765	465

33	34	35	36	37	38	39	40
475	716	546	475	567	567	675	675
345	333	444	555	666	666	747	777
555	765	676	724	292	453	432	312
567	444	555	665	314	666	375	453
825	345	203	343	989	888	888	999
654	567	786	888	524	545	675	666

41	43	45	47	49	51
169744	186624	15129	139129	585225	622521
45796	294849	47961	244036	294849	585225
20164	287296	692224	368449	609961	619369
64009	133225	525625	226576	321489	958441
123904	427716	251001	455625	204304	321489

42	44	46	48	50	52
105625	294849	431649	427716	806404	877969
283024	416025	502681	319225	767376	719104
205209	318096	585225	459684	910116	591361
189225	41209	215296	619369	245025	448900
274576	164025	824464	53824	41209	705600

53	55	57	59	61
147197952	32157432	721734273	116930169	331373888
22188041	78953589	365525875	898632125	633839779
573856191	873722816	143055667	141420761	51478848
2515456	324242703	47045881	508169592	403583412
49430863	362467097	16777216	512000000	139798359

54	56	58	60	62
420189749	31855013	340068392	571787000	447697125
122023936	485587656	599077107	30371328	102503232
904231063	647214625	53582633	8615125	16974593
304821217	209584584	28094464	103823000	761048497
390617891	76225024	125000000	272097792	799178752

1	2	3	4	5	6	7
2312	3424	4535	5646	3515	3456	6542
3521	4532	5643	6143	4626	4444	5555
4444	5555	5555	6666	2345	5321	7777
4152	5253	6264	2646	1357	5555	6666
1234	2345	3456	6543	6543	4634	2131
5555	4444	6666	5555	7777	7777	7777

8	9	10	11	12	13	14
2344	3455	4553	5634	6436	2345	4567
3541	4552	3451	1234	5641	4153	6632
1245	2455	2554	5555	4365	6666	5744
3142	4252	6666	2351	2616	4567	7371
4321	5432	1231	6666	3064	5371	3767
5555	5555	4444	4543	6602	6724	7455
4132	5243	4655	6422	2163	3452	4676
4444	4555	6543	4466	1526	7777	6543

15	16	17	18	19	20	21
1234	3456	5677	7657	4653	4312	4715
4444	5554	6666	5146	7777	7368	8654
3516	4627	3124	7777	2231	4651	9798
5223	6334	5555	4334	5445	8888	3535
2535	3646	8888	2535	3545	1324	9999
3442	4553	6773	4658	6666	9999	4444
4351	8888	4444	3441	9999	4568	7156
8888	5463	8778	9999	5678	6433	6873

22	23	24	25	26	27	28
2345	4567	6788	8768	5764	5423	5826
5555	6666	7777	6257	8888	7479	9765
4627	5738	4235	8888	3349	5764	9899
6334	7445	6666	5445	6554	9999	4646
3646	4757	9999	3646	7878	2586	8482
4553	5664	7884	5769	6666	9889	4879
5462	9999	5555	9654	9876	5679	9786
9989	6473	9889	9999	9594	7546	7968

29	30	31	32	33
89688755	76958765	98987756	98787697	78698777
85875676	97868987	76689698	77977778	89777799
66556557	98778987	99675587	97766866	96897978
69797878	89887765	87975756	78779979	67979866
97979889	87657876	65867698	77887588	78686677
97896995	76567876	98779587	56556577	89778688

34	35	36	37	38
98679675	876588888	69876845	99999999	87778787
77788654	999878965	75787876	59947784	77477666
95997667	78787777	87969997	97855987	54768597
44444846	55556787	88558988	77768877	99999999
59876589	78674444	78697779	88676575	77687749
77785999	79679876	57879767	72589648	99877887
86778577	47764969	96788654	86497769	76688998

39	40	41	42	43
100544625	947631825	987654321	740440737	531974286
43614208	496731852	296296296	846295731	159593285
500566184	429568713	123456789	253888719	319752864
315821241	317865942	370370367	957318462	959258592
208527857	489715336	975318642	287195538	824691357
185278062	125698437	292595592	137592648	247407407
485587656	734896521	864297531	412777944	682479135
162771336	125698437	259289259	264813759	204743740
51478848	798312456	135792468	294441277	468257913
726572699	124697385	407377404	753196428	140477373
961504803	987654321	246813579	225958928	468235791

44	45	46	47	48
944341717	298763052	744558367	851938262	650837965
194921823	495763052	917045937	414646084	722663844
292876979	253342659	772443591	251053798	576730087
545868274	719989713	428315784	957268371	927365970
334454297	727958966	498199714	708042744	975637995
882514332	432736552	273116859	678559317	475560738
334825232	935607544	588507745	943678876	887650978
671765192	468961782	722942796	765322345	451367244
139382142	921427722	754486133	697589876	456789929
403566977	455831690	719288497	842791975	965473695

49	50	51	52	53
919812912	386446993	491559789	134572214	184577891
763453657	125814668	235138469	381769123	673569425
287354567	219428827	276428671	147282891	123426265
983581347	283169842	425773663	263526487	852491788
723465519	246759753	796753287	927595679	579998216
236991119	975357755	337586691	883571324	533753475
832786437	521975386	937824473	986297631	774746123
247645456	977252631	864283139	163787286	364246198
542763483	135647989	255518442	341345569	671183135
219918968	475319449	196421551	865454946	822469983

54	55	56	57	58
923362677	678997687	768976897	796768989	799980798
351820362	333222444	824302543	123456021	799986798
176861416	989688776	769687978	679767676	137654235
558554821	687985976	987897769	888888888	867797869
571159284	555333111	456789321	405072316	678879899
678397578	998877666	897468579	689767899	986598976
452727523	79867678	797886759	687989477	975787667
985233343	123454321	666666666	768937898	768986697
172398252	998766767	579876498	345607432	653798798
295522779	957969787	999888777	798897798	899899898

SIMPLE MULTIPLICATION.

Third Preparatory Exercise.—*Part First.*

(The number that is equal to a given number of times the same digit.)

Consists in multiplying every digit in each of the following arrangements by the digits successively in their natural order—1, 2, 3, 4, 5, 6, 7, 8, 9.

That is, the pupil begins by multiplying each digit in every arrangement by 2, then the same by 3, then by 4, &c., &c. Thus, by 2, commencing with the first row below, and at the right of it, he is to say what number is equal to 5 and 5, or two fives—what number is equal to 4 and 4, or two fours—what equal to 6 and 6, or two sixes—what equal to 3 and 3, or two threes, &c., naming, of course, as before directed, the results only; thus, 10, 8, 12, 6, 4, 4, 16, 0, 2, 18.

1—9 1 0 8 2 7 3 6 4 5
2—5 4 6 3 7 0 2 8 1 9
3—9 7 5 3 1 0 8 6 4 2
4—8 6 4 2 0 9 7 5 3 1
5—1 5 7 9 3 0 2 4 6 8
6—2 4 6 8 1 3 5 7 9 6
7—8 4 6 2 9 5 7 3 1 8
8—9 5 7 3 1 8 4 6 2 9

9—1 3 5 7 9 2 6 4 8 3
10—3 1 9 7 5 2 8 6 4 4
11—4 6 8 2 5 7 9 1 3 7
12—9 8 2 1 7 6 5 3 4 5
13—9 1 8 2 7 3 6 5 4 9
14—5 4 6 3 7 2 8 1 9 8
15—1 8 3 5 4 6 7 2 9 3
16—9 7 5 3 1 8 6 4 2 7

In the same manner—that is, by counting—is he to *find out and learn* the results by 3; thus, taking for example the second row, the pupil is to say what 9 and 9 and 9, or 3 nines are equal to—what 1 and 1 and 1, or three ones are equal to—what 8 and 8 and 8, or three eights are equal to, &c., and learn to say these numbers quickly from memory, that is without counting—thus, 27, 3, 24, 6, 0, 21, &c.

The results of multiplying by 4, 5, 6, 7, 8, and 9, might all be found in the same way as those by 2 and 3 were found above—that is, by counting; but, for the sake of saving the time necessarily spent in counting, these, as also the results by 2 and 3, are written in what is called the "Multiplication Table," in their natural order, that is, just as they occur in the Table of Counting. This Multiplication Table is to be used to find the results by 4, and the higher digits in this way:—Let the pupil be required to learn to multiply by 4 the numbers of the third arrangement above, and let him be told that he will find what four twos are under "4 times" in the Table, at page 7, opposite 2; that he will find what four fours are, also under "4 times," but opposite 4; what four sixes are under "4 times," opposite 6; what four eights are, under "4 times," opposite 8; and so with all the rest. Thus, all the results by 4 are found under "4 times," opposite the particular number the result of which is wanted.

In the same manner the pupil may find the results by 5 under "5 times," those by 6 under "6 times," those by 7 under "7 times," those by 8 under "8 times," and those by 9 under "9 times," *and thus learn them off.*

THIRD EXERCISE.—*Part Second.*

Part Second of this Exercise is a *written* revision of Part First.

It consists in multiplying the numbers at the top of the following Table by each of those in the margin, in succession, and *writing* the results in the same line as the marginal number, under the numbers of the top line, whose products they are respectively, as indicated by 3 below.

1.	5	8	3	7	2	9	4	6	8	7	9	6
3.	15	24	9	21	6	27	12	18	24	21	27	18
7.												
5.												
2.												
4.												
9.												
6.												
8.												

THIRD EXERCISE.—*Part Third.*

Part Third is another revision in a different form of Part First, and consists in multiplying together every two figures of each of the following rows, (or any other line of figures); thus, the first row, 9, 4, 7, 5, 8, 2, 6, 3, 1, is resolved into 9×4, or 36; 4×7, or 28; 7×5, or 35; 5×8, or 40; 8×2, or 16; 2×6, or 12; 6×3, or 18; 3×1, or 3; or, simply, 36, 28, 35, 40, 16, 12, 18, 3, as previously directed.

9 4 7 5 8 2 6 3 1	8 8 2 9 5 3 6 7 4	3 0 2 7 5 9 6 8 4
4 6 8 2 3 5 7 9 1	9 1 8 2 7 3 6 4 5	4 3 8 2 0 7 9 1 5
9 8 2 1 7 6 5 3 4	2 3 7 5 9 1 4 8 6	5 8 0 9 7 6 0 3 4
3 5 4 6 7 1 2 8 9	1 4 7 5 9 2 6 3 8	7 1 8 0 0 2 9 6 1

FOURTH EXERCISE.—*Part First.*

Consists in multiplying every two figures of each row together, and then adding to their product the next figure of the row. Thus, the first row, 9, 4, 7, 5, 8, 2, &c., resolves itself into 9×4+7, 4×7+5, 7×5+8, 5×8+2, &c., or simply thus—43, 33, 43, 42, &c.

FOURTH EXERCISE.—*Part Second.*

Multiply the above numbers by the digits in their natural order, as in the first part of the Third exercise, *adding* to each product the *left hand figure* of the preceding product; thus—let it be required to multiply 7, 6, 3, 4, by 6, it is resolved into 4×6, or 24 (first prod.)—3×6+2, or 20—(second prod.)—6×6+2, or 38 (third prod.)—7×6+3, or 45 (fourth and last prod.); or, simply, 24, 20, 38, 45.

Note.—The difference between the two parts of this Exercise is, that in the first the additive is *seen*—in the second it is retained in the memory.

1. 8642×2
2. 5286×2
3. 9531×2
4. 1579×2
5. 7342×3
6. 2832×3
7. 8569×3
8. 4953×3
9. 7376×4
10. 7826×4
11. 5973×4
12. 3954×4
13. 8327×5
14. 4819×5
15. 2347×5
16. 1874×5
17. 5444×6
18. 7895×6
19 8456×6
20. 6789×6
21. 667745×2
22. ———×3
23. ———×4
24. ———×5
25. 697745×6
26. 357986×2
27. ———×3
28. ———×4
29. ———×5
30. ———×6
31. 479568×2
32. ———×3
33. ———×4
34. ———×5
35. ———×6
36. 28641×7
37. 18624×7
38. 75931×7
39. 15379×7
40. 88264×8
41. 42889×8
42. 71599×8
43. 99517×8
44. 66666×9
45. 77888×9
46. 99988×9
47. 98798×9
48. 397586×7
49. ———×8
50. ———×9
51. 107080×7
52. ———×8
53. ———×9
54. 7009001×7
55. ———×8
56. ———×9
57. 34567×6
58. 45678×7
59. 56789×8
60. 98765×9

61. 9407631825 × 7
62. 4906735182 × 8
63. 4209568718 × 4
64. 8107865942 × 8
65. 489715236 × 9
66. 125698437 × 6
67. 734896521 × 5
68. 738495621 × 2
69. 2159674038 × 6
70 7983124057 × 7
71. 1246973085 × 8
72. 6325179084 × 9

Find the continued product of the following.

Note.—This and the next Section are preparatory to Compound Multiplication, by factors.

73. 7385×2×2
74. ——×3 - 3
75. ——×4 - 4
76. ——×5 - 5
77. ——×6 - 6
78. 7986×2 - 3
79. 6198×3 - 4
80. ——×4 - 5
81. ——×5 - 6
82. ——×6 - 7
83. ——×7 - 8
84. 564976×3×3
85. ———×4 - 4
86. ———×5 - 5
87. ———×6 - 6
88. 737869×4 - 5
89. ———×7 - 8
90. ———×9 - 6
91. ———×5 - 9
92. 926384×7 - 7
93. ———×8 - 9
94. ———×9 - 8
95. 8976506×2×3×4
96. ————×3 - 4 - 5
97. ————×4 - 5 - 6
98. ————×5 - 6 - 7
99. ————×6 - 7 - 8
100. ————×7 - 8 - 9
101. ————×8 - 7 - 9
102. 5679843×3 - 4 - 5
103. ————×4 - 5 - 6
104. ————×5 - 6 - 7
105. ————×6 - 7 - 8

Multiply by the Factors of the following Multipliers.

106. 98763182×14
107. 49673518×15
108. 17865924×24
109. 495608713×28
110. 325107984×40
111. 734809652×48
112. 72659483 × 63
113. 34769521 × 72
114. 54213898 × 81

115. 7658 × 10*
116. 6915 × 100
117. 7821 × 1000
118. 9563 × 10000
119. 6485 × 300
120. 6057 × 700
121. 9438 × 900
122. 6638 × 800
123. 15040 × 100
124. 60509 × 10
125. 4730 × 600
126. 7500 × 4000

127. 76593 × 11
128. 64738 × 11
129. 91713 × 12
130. 39179 × 12
131. 64568 × 11
132. 64568 × 12

---

* Learn the 10th, 11th, and 12th lines of the Table, *as the others* were learned.

SIMPLE DIVISION.—First Exercise.

(To find how often each digit is contained in a number not more than 9 times itself.)

Consists in discovering how often each digit in the margin of the following Table is contained in each number on the right of it.

2.	10	4	16	2	6	12	14	8	18	12	10	14	2
3.	6	15	24	3	9	21	18	27	12	18	15	21	3
4.	12	4	28	32	24	20	36	8	16	32	28	24	32
5.	10	20	45	25	30	40	35	5	15	45	25	20	25
6.	36	18	12	30	6	42	54	48	24	30	6	12	30
7.	49	21	28	56	63	42	35	14	7	56	56	21	56
8.	8	16	40	48	72	32	64	24	56	40	40	8	48
9.	48	9	72	27	63	36	54	18	81	45	9	72	27

Second Exercise.—The numbers of the following table are not an exact number of times the marginal number; and this exercise consists chiefly in discovering how many *each* is *more than* the nearest exact number which it contains. Thus the first marginal number below is 5, and the first three numbers on the right of it are 46, 17, and 6. Now, so far as these numbers are concerned, the exercise aims at the pupil's at once perceiving that 46 is *one more* than 9 times 5—that 17 is *two more* than 3 times 5—that 6 is *one more* than once 5; and this is in the exercise expressed 9 and 1, 3 and 2, 1 and 1, &c. The first thus expresses the nearest exact number of times that the marginal number is contained in the numbers respectively on the right, and the second one that which must be added to the nearest exact number of times to make up the numbers of the table respectively. One word more than 9 and 1 is unnecessary, and consequently worse than useless.

5.	46	17	6	37	44	34	28	48	21	12	13
7.	58	8	16	58	45	67	60	33	27	55	47
3.	19	14	38	22	23	10	5	26	16	7	17
6.	31	29	51	58	44	7	35	16	19	39	20
2.	13	19	9	15	13	7	3	17	5	11	19
9.	46	88	22	59	39	67	31	79	17	58	35
4.	35	17	10	38	21	27	34	30	7	14	25
8.	42	60	29	69	88	76	51	47	22	13	62

Third Exercise.—Consists in discovering how often each digit in the margin of the following Table is contained in the numbers on the right of it. For this purpose the number is divided into parts, consisting of one figure each, except when the first figure of the number is less than the digit in the margin, in which case the *first part* must consist of the first two figures.

Then the pupil says how often the digit is contained in the first part; and if a number must be added *to this number of times* to make up the first part (without naming it), it is placed before the next figure, at present constituting the second part, thus forming a number of two figures, which is *now* considered the *second part*. The pupil then says, as before, how often the digit is contained in this part; and if again it is necessary to add to this number of times a number *to make up* the second part, this additive is, as above, placed before the next figure, thus again making a number of two figures, which becomes the *third part.* With this and each succeeding part the pupil proceeds as with these two first parts. When, however, any part is an exact number of times the digit, the next part consists of the next figure alone, in which it is possible the digit is not contained at all. When this is the case, the pupil just says so, or shortly the word *nought.*

Thus, let the pupil be required to find how often 3 is contained in the first number below, viz., 1375648. As taught above, he begins by dividing it into (or supposing it divided into) 13, 7, 5, 6, 4, 8; then, as he must name the results only, he begins the process by saying *four* (the number of threes that are in 13, the first part); next he says *five* (the number of threes that are in 17, which is formed of the next part 7, and the one which was necessary to make up the last part, 13); then he says eight (the number of threes contained in 25, 25 being formed as the 17 was formed above); lastly, he says five, four, nine, and one over, all of which are found, as the four, five, and eight just named.

3.	1375 648	921663 0457	42851 6748 8346
5.	3957 430	104567 0875	92882 9946 7677
2.	1185 276	192730 1004	44531 7243 6668
6.	4558 076	453702 0672	85008 2202 3659
4.	1071 660	802803 4420	73019 7658 8290
7.	6732 968	952702 1035	19001 0204 7491
9.	3462 831	216396 7033	75303 5774 9652
8.	4262 912	109488 8176	60980 0017 2700

Note.—In the preceding are all the elements of Long Division.

1. $\frac{8642}{2}$	6. $\frac{8642}{3}$	11. $\frac{91375}{4}$	16. $\frac{13975}{5}$	21. $\frac{2864}{7}$	26. $\frac{95137}{8}$
2. $\frac{4286}{2}$	7. $\frac{95713}{3}$	12. $\frac{57319}{4}$	17. $\frac{6428}{6}$	22. $\frac{4682}{7}$	27. $\frac{78159}{8}$
3. $\frac{97531}{2}$	8. $\frac{31759}{3}$	13. $\frac{4682}{5}$	18. $\frac{8246}{6}$	23. $\frac{97531}{7}$	28. $\frac{6248}{9}$
4. $\frac{13579}{2}$	9. $\frac{2568}{4}$	14. $\frac{6284}{5}$	19. $\frac{71359}{6}$	24. $\frac{15973}{7}$	29. $\frac{73591}{9}$
5. $\frac{8246}{3}$	10. $\frac{2864}{4}$	15. $\frac{19753}{5}$	20. $\frac{53179}{6}$	25. $\frac{4628}{8}$	30. $\frac{19537}{9}$

A PREPARATION FOR REDUCTION AND DIVISION BY FACTORS.

31. 1587600÷3÷2
32. ....÷2÷4
33. ....÷4÷3
34. ....÷5÷2
35. ....÷6÷3
36. 3175200÷4÷4
37. ....÷5÷4
38. ....÷3÷6
39. ....÷7÷3
40. ....÷6÷4

41. 4762800÷5÷5
42. ....÷3÷9
43. ....÷6÷5
44. ....÷4÷7
45. ....÷7÷5
46. 19051200÷4÷8
47. ....÷6÷6
48. ....÷5÷8
49. ....÷7÷6
50. ....÷9÷5

51. 38102400÷ 6÷ 8
52. ....÷ 7÷ 7
53. ....÷ 5÷10
54. ....÷ 9÷ 6
55. ....÷ 8÷ 7
56. 76204800÷ 6÷10
57. ....÷ 7÷ 9
58. ....÷ 8÷ 8
59. ....÷10÷ 7
60. ....÷ 9÷ 8

---

61. 65318400 ÷ 2 ÷ 3 ÷ 4
62. .... ÷ 3 ÷ 4 ÷ 5
63. .... ÷ 5 ÷ 3 ÷ 2
64. .... ÷ 6 ÷ 5 ÷ 3
65. 195955200 ÷ 6 ÷ 4 ÷ 5
66. .... ÷ 5 ÷ 6 ÷ 7
67. .... ÷ 8 ÷ 7 ÷ 6
68. .... ÷ 7 ÷ 5 ÷ 9
69. 261273600 ÷ 6 ÷ 8 ÷ 9
70. .... ÷ 7 ÷ 8 ÷ 9
71. .... ÷ 9 ÷ 8 ÷ 8
72. .... ÷ 2 ÷ 3 ÷ 4

73. 130636800 ÷ 3 ÷ 4 ÷ 5
74. .... ÷ 4 ÷ 2 ÷ 5
75. .... ÷ 5 ÷ 4 ÷ 6
76. .... ÷ 6 ÷ 7 ÷ 3
77. 391910400 ÷ 6 ÷ 5 ÷ 3
78. .... ÷ 5 ÷ 6 ÷ 7
79. .... ÷ 2 ÷ 7 ÷ 3
80. .... ÷ 4 ÷ 2 ÷ 8
81. 783820800 ÷ 8 ÷ 3 ÷ 5
82. .... ÷ 7 ÷ 4 ÷ 8
83. .... ÷ 6 ÷ 7 ÷ 8
84. .... ÷ 9 ÷ 5 ÷ 9

Divide by the factors of the following divisors. If right, there will be no remainders.

85. 38102400 ÷ 20
86. .... ÷ 18
87. .... ÷ 21
88. .... ÷ 24
89. 57153600 ÷ 25
90. .... ÷ 27
91. .... ÷ 30
92. .... ÷ 28

93. 57153600÷35
94. 228614400÷32
95. ....÷36
96. ....÷40
97. ....÷42
98. ....÷45
99. 457228800÷48
100. ....÷49

101. 457228800÷50
102. ....÷54
103. ....÷56
104. 914457600÷60
105. ....÷63
106. ....÷64
107. ....÷70
108. ....÷72

When two factors are used and remainders occur, multiply the last remainder by the first divisor, and add the first remainder to the product.

109. 76387353÷18
110. ....÷24
111. 75259327÷25
112. ....÷27
113. 75930286÷30

114. 73654877÷28
115. ....÷35
116. ....÷40
117. ....÷42
118. ....÷49

119. 30870379÷50
120. ....÷54
121. 75259327÷56
122. ....÷60
123. ....÷72

124. 754130 ÷ 10
125. 679506 ÷ 10
126. 5600 ÷ 10 ÷ 10
127. 2900 ÷ 100
128. 3000 ÷ 100
129. 6720 ÷ 2 ÷ 10
130. 36720 ÷ 30
131. 7320 ÷ 40
132. 68000 ÷ 800

When the divisor contains a fraction.

133. 75348659 ÷ $2\frac{1}{4}$
134. 918274635 ÷ $2\frac{1}{4}$
135. 593168427 ÷ $5\frac{1}{2}$
136. 724861395 ÷ $5\frac{1}{2}$
137. 812975364 ÷ $2\frac{3}{4}$
138. 463579218 ÷ $2\frac{3}{4}$

Exercises in which two or more of the elementary processes are combined.

1. 304705 ÷ 5 × 2
2. 229035 ÷ 3 × 2
3. 76345 ÷ 5 × 4
4. 305380 ÷ 4 × 3
5. 305380 ÷ 5 × 3
6. 534415 ÷ 7 × 4
7. 687105 ÷ 9 × 5
8. 840656 × · ÷ 6
9. 604356 × 3 ÷ 6
10. 769016 × 7 ÷ 8
11. 936639 × 7 ÷ 9
12. 378906 × 7 ÷ 11
13. 609873 × 9 ÷ 11
14. 408780 × 11 ÷ 12
15. 391910400 × $\frac{3}{5}$
16. .... × $\frac{2}{5}$
17. .... × $\frac{3}{8}$
18. .... × $\frac{5}{8}$
19. 783820800 × $\frac{4}{7}$
20. .... × $\frac{5}{12}$
21. .... × $\frac{7}{12}$

When the fraction in the multiplier is less than a whole number by *one of its parts*, it is better to increase the multiplier by that *one part*, and from the product subtract *that one part of the multiplicand.*

Ex. 75683 to be multiplied by $7\frac{5}{6}$.

$$\begin{array}{r} 75683 \\ 8-\frac{1}{6} \\ \hline 605464 \\ 12613\frac{5}{6} \\ \hline 592850\frac{1}{6} \end{array} = 75683 \times 7\frac{5}{6}$$

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22. 637101 × $4\frac{1}{3}$
23. 916140 × $5\frac{1}{4}$
24. 229035 × $6\frac{1}{5}$
25. 534415 × $7\frac{2}{3}$
26. 534415 × $8\frac{3}{4}$
27. 1208712 × $9\frac{4}{5}$
28. 1068830 × $15\frac{5}{7}$
29. 2307048 × $24\frac{7}{9}$
30. 817564 × $42\frac{7}{11}$

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31. 6780 × $2\frac{2}{3}$ × 4
32. 8617 × $4\frac{5}{7}$ × 12
33. 65318400 × $7\frac{2}{3}$ × $8\frac{3}{4}$
34. 65318400 × $4\frac{5}{6}$ × $9\frac{7}{8}$
35. 195955200 × $5\frac{3}{4}$ × $7\frac{6}{11}$
36. 195955200 × $8\frac{2}{3}$ × $7\frac{2}{3}$

37. From the sum of 7684+67895+97680 subtract 70976.

38. Subtract 30075 from the sum of 98+765+86754+9839.

39. Multiply the sum of 732+4356+672+9876+975 by 7.

40. .... 98674+76536+9875+ by 4×7×9.

41. Divide the sum of 34567+7863+9876+789 by 8.

42. .... 4678+97+864+70001+25 by 7.

43. From the sum of 1765+987+1756+405+800+901+83, subtract the sum of 2653+656+21+56+365.

44. From the sum of 3001+765+98765+9765+3450+99, subtract the sum of 96+9876+5006, and multiply the remainder by 9.

45. Multiply 5007 by 7, 876 by 9, 209 by 81, and from the sum of the products, subtract the sum of the following products:—456×5, 643×6, 906×7, and 80×90.

46. Multiply 645 by 5, 645 by 40, and 645 by 600, and from the sum of the products subtract 546×6, 546×40, and 546×500.

47 Multiply 325 by 7, 532 by 90, 352 by 700, and from the sum of the products subtract the sum of the following products: 235 by 9, 235 by 70, and 235×700.

48. From the sum of 645+9750+3797+6581+9773 subtract (7524—97,) and divide the remainder by 42.

49. From the sum of 6786+6485+64803+765+6374+98+379817 subtract the sum of the following products, viz. 762×56, 89×96, 678×64, and 987×72, and divide the remainder by 63.

50. Add together 279+7684+9783+698, from their sum subtract 9724, multiply the remainder by 63, and divide the product by 36.

NUMERATION.

The following are the names, which, by agreement, have been given to numbers.

One.
Two.
Three.
Four.
Five.
Six.
Seven.
Eight.
Nine.
Ten.

Eleven = ten and one.
Twelve = ten and two.
Thirteen = ten and three.
Fourteen = ten and four.
Fifteen = ten and five.
Sixteen = ten and six.
Seventeen = ten and seven.
Eighteen = ten and eight.
Nineteen = ten and nine.
Twenty = ten and ten.

Twenty-one = two tens and one.
Twenty-two = two tens and two.
&c. &c.
Thirty = three tens.
&c. &c.
Forty = four tens.
&c. &c.
Fifty = five tens.
Sixty = six tens.
Seventy = seven tens.
Eighty = eight tens.
Ninety = nine tens.
A hundred = ten tens.

A hundred and one = ten tens and one.
A hundred and ten = ten tens and ten.
A hundred and forty = ten tens and forty.
&c. &c. &c. &c.
A thousand = ten hundreds.
Ten thousands
A hundred thousands

A million = ten hundred thousands.
= a *thousand* thousands.
Ten millions.
A hundred millions.

A billion = a *thousand* millions.
A trillion = a *thousand* billions.
A quadrillion = a *thousand* trillions.
&c. &c.

Note.—Up to the name million all arithmeticians are agreed as to the number which each shall be understood to represent. We differ, however, from the French arithmeticians and others in the value which we have hitherto assigned to the billion and the higher class denominations. A billion has been in this country generally understood to represent a *million* millions, a trillion a *million* billions, and so on; but in France and elsewhere it means only a *thousand* millions, and a trillion a *thousand* billions, &c.

In the English system fewer names are necessary for the numbers above hundreds of millions. In the French system the relation between the names or numbers is much simpler. Thus each, in point of simplicity, has a peculiar advantage over the other. But as the numbers above hundreds of millions seldom require to be expressed, the simplicity *of the relation of the numbers*, in the French system, it is thought, more than counterbalances the advantage *of fewer names* possessed by that of the English. The French numeration is, consequently, now generally adopted even in this country.

Notation.

1, 2, 3, 4, 5, 6, 7, 8, 9, are called digits, and 0 the cipher.
The first nine numbers are expressed by the digits alone.

Write one, seven, nine, six, eight, four, five, two, three.

Ten, *twenty*, and the other exact numbers of tens, are expressed by the digits with *one cipher* annexed except when one of the former section is named along with the exact number of tens, in which case the digit, as in the former section, takes the place of the cipher. Twenty is expressed thus, 20, and twenty-four thus, 24.

Write ten, forty, seventy, twenty, sixty, ninety, fifty, eighty, eleven, fifteen, thirty-two, seventy-seven, forty-five, fifty-four.

> *Hundreds* are expressed by the digits and *two ciphers* annexed; and in the case of lower numbers being expressed along with the hundreds, such numbers as directed above take the place of one or both ciphers; thus, seven hundred is written thus, 700—seven hundred and forty, 740—seven hundred and four, 704—and seven hundred and forty-four, 744.

Write two hundred, nine hundred, eight hundred, six hundred, two hundred and twenty, six hundred and eighty, five hundred and ten, two hundred and six, nine hundred and seven, four hundred and three, two hundred and fifty-one, eight hundred and forty-five, and seven hundred and seventy-seven.

> *Thousands* are expressed by the digits with *three ciphers* annexed, or, instead of the ciphers, digits *for the lower numbers*, as above.

Write three thousand, eight thousand, six thousand, and nine thousand, three thousand and seven, six thousand and three, five thousand and eight, three thousand and seventy-four, eight thousand and sixty-six, four thousand and forty, three thousand nine hundred, seven thousand one hundred, one thousand seven hundred, six thousand nine hundred and forty-two.

> *Tens of thousands* are expressed by the digits with *four ciphers* or digits annexed as above.

Write fifty thousand, ninety thousand, forty thousand, sixty thousand, fifty-one thousand, seventy-six thousand, eighteen thousand, nineteen thousand seven hundred, ninety-one thousand one hundred, fifty-three thousand two hundred and fifty, thirty-five thousand seven hundred and sixty, ninety-five thousand and forty-four, ninety thousand and seventy-six, fifty thousand and forty-six, seventy thousand and one.

> *Hundreds of thousands* are expressed by the digits with *five ciphers* or digits annexed, as above.

Write nine hundred thousand, six hundred thousand, one hundred thousand, seven hundred thousand and four, one hundred thousand and three, six hundred thousand and forty-two, two hundred thousand and sixty-three, eight hundred thousand four hundred and sixty, three hundred thousand seven hundred and twenty, seven hundred thousand two hundred and six, five hundred thousand nine hundred and one, five hundred and seven thousand three hundred and three, six hundred and one thousand six hundred and one, two hundred thousand and ten, seven hundred thousand and fifty, one hundred thousand five hundred, four hundred thousand three hundred and sixty-one, seven hundred and one thousand and sixty-five, nine hundred and sixty-one thousand one hundred and eleven.

> *Millions* are expressed by the digits with *six ciphers* or digits annexed, as above.

Write one million, nine millions, forty millions, seventy millions, eighteen millions, thirty-one millions, six hundred millions, nine hundred millions, seven hundred and forty millions, three hundred and ninety millions, one hundred and four millions, seven hundred and sixty-five millions, nine millions five hundred and forty-nine thousand, seven millions six hundred and eighty thousand, nine millions eight hundred and fifty thousand, sixty-one millions four hundred and one thousand, nine hundred and seven millions one hundred and eleven thousand, seventy-seven millions four hundred and five, eighty-nine millions six hundred and forty, seven hundred millions two hundred and sixty thousand four hundred and five, nine hundred and four millions seven hundred and nineteen thousand nine hundred and four, three hundred and three millions three hundred and three thousand three hundred and three, two hundred and sixty millions three hundred and ninety-eight, nine hundred and fifty-seven millions six hundred and twenty-one thousand four hundred and eighty.

> *Billions* are expressed by the digits and *nine ciphers* annexed, or digits as above; *trillions* by *twelve ciphers;* and *quadrillions* by fifteen ciphers or digits as above.

Write a billion, a trillion, a quadrillion, nine hundred and ninety-nine billions, nine hundred and ninety-nine trillions, one trillion two billions three millions four thousand and five.

Read or write in words the following numbers:—

7—9—10—80—50—77—645—650—605—7005—7065—7605—7650—90001—91000—90100—90010—905760—900576—761640—8000000—8000800—17001700—17017000—71017081—63756895—685000603256—708030706050—5007600980073008—768937658973106716.

Questions to be answered by the pupil as soon as possible after learning the above.

1. How are the figures of a number usually divided, for convenience in reading?

2. What is the name of the first four classes, and how many figures do they include?

3. How many ciphers would it be necessary to annex to the digits, to express thousands—hundreds—tens—tens of thousands—millions—and tens of millions?

4. What does the fourth figure express?—what the third?—the first?—the fifth?—the seventh?—and the ninth?

5. How many figures are necessary to express thousands—hundreds—tens of thousands—millions—and hundreds of millions respectively?

6. What does the number on the left of the first three figures represent?—what on the left of the first four? –what on the left of the first six?—on the left of the *first* figure?—on the left of the second?—on the left of the ninth?

7. How many millions, tens of thousands, thousands, and hundreds respectively are in the number 768530796?

8. A figure in the second place is how many times the same [figure in the first?

—————— third —————————————— second?
—————— third —————————————— first?
—————— fourth —————————————— third?
—————————————————————— second?
—————————————————————— first?
—————— fifth —————————————— fourth?
—————— fifth —————————————— second?
—————— fifth —————————————— first?
—————— sixth —————————————— third?
—————— sixth —————————————— first?
—————— eighth —————————————— fourth?
—————— ninth —————————————— third?

9. What difference on the value of a digit does moving it one place to the left make? what difference by moving it two places to the left? and what by moving it three, five, seven, to the left?

10. Two thousand is how many times two hundred? two thousand is how many times twenty? twenty is how many times two?

11. How many times is a digit in the units, tens, or hundreds of one class greater than the same figure in the same place of the next lower?

12. Three hundred thousand is how many times three hundred? one million is how many times one thousand? and twenty billions is how many times twenty millions?

13. A figure in the third place is what part of the same figure in the fourth? a figure in the second place is what part of the same figure in the third? and a figure in the first place is what part of the same figure in the second?

14. If you move a figure one place to the right to what extent do you change its value? two places, to what extent do you change it? or three, four, five, six places, to what extent do you change it?

15. What part is one hundred thousand of one million? what part is ten thousand of one hundred thousand? what part is one thousand of ten thousand? what part of a thousand is one hundred? what part of one hundred is ten? and what part of ten is one?

Exercises chiefly in Notation.*

1. Add together seven hundred and fifty-six, forty-eight, nine hundred and thirty, three hundred and one, and five.

2. Add together forty, one hundred and four, seventy-six, nine hundred and eight, and seven hundred and ninety-eight.

3. Add three thousand four hundred and sixty-one, three thousand and two, four thousand two hundred, six thousand and seventy.

4. Subtract ten thousand and nine from the sum of seven thousand and sixty-eight, five thousand and seventy-six, and three thousand and seven.

5. From the sum of nine thousand eight hundred and thirty-six, two thousand and seven, and nine thousand and eighty, subtract fourteen thousand and fifty.

6. Multiply four hundred and seventy-five by twenty.

7. Multiply three hundred and nine by five hundred.

8. Multiply two hundred by one hundred.

9. Multiply the sum of seventy-six, five hundred and four, and five thousand and three, by seven.

10. Multiply the sum of ninety, ninety-nine, and seven thousand nine hundred, by seven thousand.

11. Add together, nine thousand and ninety and seven thousand and seventy, from their sum subtract ten thousand five hundred and seventy-six, and multiply the remainder by forty.

12. Add together seven thousand three hundred and forty-six, six thousand four hundred and eighty, and ninety thousand five hundred and nine, from their sum subtract one hundred thousand one hundred, and multiply the remainder by ninety.

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* The answers to the above should be written in words.

1	2	3	4	5	6	7
15326	34512	12321	23443	51324	38222	22152
23651	43254	29678	58164	34256	64333	35653
44444	51023	43781	34517	85173	79574	44374
34554	23434	34545	36374	59645	42465	73545
78877	96765	87654	43659	16374	81557	86296
34567	98765	98765	23145	67185	93646	67357
75298	34534	55446	65286	72566	64637	78468
34561	51267	63512	39493	89457	75789	89579

8	9	10	11	12	13	14
23651	34512	87654	34517	16374	42465	22132
62315	51267	87654	36374	67185	81557	35653
44544	98765	34545	58164	72566	93646	44374
34565	43254	43781	23443	89457	64637	73545
78345	76215	55446	43659	37158	75789	69268
87767	23434	29678	23145	59645	47957	67357
75298	34534	12321	65289	51324	64333	78468
34561	51023	63512	93943	85173	38222	89579
16543	98765	23516	23456	45689	56787	47674

15	16	17	18	19	20	21
46272	45673	76765	71236	45677	67468	76466
54323	66664	23456	41247	91238	43197	97579
55554	57385	37713	98915	66873	59245	76754
63345	74456	62764	37996	78374	65936	63455
36466	47577	76452	24563	84795	76497	67126
45352	86424	67343	79124	57996	87598	34566
54623	38795	56177	96335	13137	43179	97897
99894	63246	23458	77948	37279	54263	37678
45755	79137	68797	98259	14568	65374	26769

22	23	24	25	26	27	28
66947	45678	45678	87676	47676	72766	45666
77897	84567	71846	12677	87857	39778	57567
67718	12345	24573	88991	67671	45126	19807
71671	76543	56646	23478	45678	74366	57676
82532	88888	77579	78967	67895	54976	76799
93476	48195	61877	12345	96389	67695	62657
64367	42965	24683	73767	75264	76769	37664
75871	39764	57946	12671	28517	12345	47674
84556	98759	51576	84567	54448	76777	56789

29	30	31	32	33	34	35
98276	26939	89216	17998	8287	68973	92288
98876	78885	27358	75868	65328	79857	38375
54423	46795	6472	67758	42475	95747	46497
98576	88694	87550	46654	86578	68698	93528
8653	97527	46689	97568	92613	76559	91685
4769	68454	58764	8436	75784	53489	95747
98876	74385	5874	9379	56878	54332	86898
48952	63294	91983	287	9965	87265	72994
98476	6539	7649	1773	9867	46738	65488
67789	84876	88757	94769	2845	91857	79918

36
3947716789
9345192744
137465450
8396421064
7960255726
4938875169
8992744054
6143397186
4578027648
6217156869

37
7867695248
7859546135
4573736854
1438484745
6691543876
98732514
54219867
654765234
21983713
4542191454

38
2198676541
4325948676
541457688
79846888
7875597456
7354871298
4664836
2192761429
8412175387
970874578

39
5786761645
7938459487
5453637864
5154883476
4379358994
232735945
68935945
4866837
7548696841
32389137

40
9765952789
2181273175
3367829276
3515478925
6145825556
2815752365
6268543200
7015763259
7325973589
2684384362

41
9268436291
8436295942
1784387124
6054639145
6549687546
7345789362
8476321365
1978639854
2162876432
6434564872

42
8245635939
9872147684
3540987654
2798674154
6798314657
4297954623
2537854364
7891346287
4437638924
7721454867

43
9739656584
5786758948
1766867148
2234176867
8703482488
2978687487
1266213487
6984617892
8954327084
2985358932

44
7176487341
2345677267
5789229875
6773898757
6675789274
8796348391
5487758291
8562918374
6928593727
3951977654

45
4224768446
7643254389
7647274389
1560274857
6420800
207513492
71165
1845755036
8197352051
5157639482

46
4868257913
1928374651
1352794681
5932786454
6372819987
4653219821
7653491827
3645319275
8641852906
3497523840

47
1627384395
4053982175
6427135997
5286542680
9419453510
6317421973
852525418
6509438475
2472638720
8439814276

48
5768934437
7773867514
3678762492
4014796789
4175308010
827342
1100000000
6125382999
45879838
8888845697

49
5132885666
2679886555
2134741796
8833333175
9176584213
3497647368
3013257293
4674382566
1679643206
4568374457

50
1631781863
4967818451
3291476283
4762137223
9341768349
3413785678
4169138763
5434793753
1276283178
4987648341

51
37659172
76546389
29837816
56379826
31755929
83792897
63457912
14567829
23456789
54763829
27368125

52
476259876
572398779
976498397
657929371
564733224
567893297
756834798
398765432
135799753
246824680
737394949

53
798976598
142355432
677669767
645564654
987798479
567895432
423172964
798367455
839267744
798375547
347623854

54
772865497
626513248
345678929
379798999
654479564
375847399
674297634
835628973
172654939
369719587
791976459

55
759107203
654707958
782987658
732987658
491285937
345678929
768498537
796849758
856973975
345671973
632956748

In the first two columns of these Exercises, the Subtrahend is to be taken *twice* from the Minuend; and in the last two, it is to be taken away four times. In both cases, the last remainder should be equal to the Subtrahend.

1
987654321
2962962963

2
123456789
370370367

3
975318642
2925955926

4
864297531
2592892593

5
135792468
407377404

6
246813579
740440737

7
846295731
2538887193

8
957318462
2871955386

9
137592648
412777944

10
264813759
794441277

11
753196428
2259589284

12
531974286
1595922858

13
319752864
959258592

14
824691357
2474074071

15
682479135
2047437405

16
468257913
1404773739

17
468235791
1404707373

18
6428 3719
1928561157

19
917358264
2752074792

20
982176534
2946529602

21
354671289
1064013867

22
128958674
386861022

23
476359821
1429079463

24
918273645
2754820935

25
791486
3957430

26
592638
2963190

27
759846
3799230

28
267915
1339575

29
976134
4880670

30
293645
1468225

31
681354
3406770

32
384759
1923795

33
532864
2664320

34
253796
1268980

35
671289
3356445

36
897435
4487175

37
294713
1473565

38
196738
983690

39
853416
4267080

40
735294
3676470

41
137462
687310

42
453198
2265990

43
358967
1794835

44
536821
2684105

45
372519
1862595

46
546729
2733645

47
645381
3226905

48
486237
2431185

1. 2474 × 32
2. 5742 × 23
3. 8352 × 43
4. 5823 × 34
5. 8888 × 45
6. 7777 × 54
7. 8396 × 63
8. 9360 × 56
9. 3986 × 64
10. 9729 × 73
11. 9297 × 65
12. 3667 × 75
13. 4765 × 67
14. 6785 × 232
15. 8756 × 343
16. 7685 × 474
17. 3974 × 565
18. 5678 × 432
19. 7568 × 543
20. 8576 × 654
21. 8388 × 676
22. 8838 × 667
23. 9334 × 787
24. 5827 × 788
25. 6737 × 954
26. 7449 × 876
27. 24758 × 232
28. 87524 × 343
29. 58396 × 454
30. 93856 × 565
31. 13578 × 432
32. 53187 × 543
33. 88517 × 654
34. 86249 × 676
35. 92486 × 667
36. 49286 × 787
37. 73455 × 788
38. 74949 × 954
39. 47575 × 876
40. 3239 × 1675
41. 3348 × ——
42. 3384 × ——
43. 3492 × ——
44. 4453 × 7863
45. 5566 × ——
46. 6577 × ——
47. 6688 × ——
48. 6709 × 8975
49. 7345 × 8975
50. 5074 × ——
51. 9409 × ——
52. 5753 × ——
53. 9815 × 203
54. 8175 × 507
55. 6688 × 604
56. 6709 × 450
57. 7045 × 730
58. 5009 × 960
59. 7004 × 300
60. 4947 × 600
61. 13500 × 830
62. 73000 × 720
63. 54000 × 600
64. 67100 × 930

---

65. 9876054321 × 701
66. 1234056789 × 805
67. 9753108642 × 341
68. 8642907531 × —
69. 1357902468 × —
70. 2468130579 × 432
71. 2462905731 × —
72. 9573180462 × —
73. 1370592648 × 534
74. 2648137059 × —
75. 7531906428 × —
76. 5310974286 × 362
77. 3197528064 × —
78. 8246091357 × —
79. 682479135 × 643
80. 468257913 × —
81. 468234791 × —
82. 462853719 × 465
83. 917358264 × —
84. 982176534 × —
85. 354671289 × 673
86. 128953674 × —
87. 476359821 × —
88. 918273645 × 897
89. 192837464 × —
90. 564738291 × 986
91. 546372819 × —
92. 987654321 × —
93. 235791486 × 239
94. ———— × 348
95. ———— × 384
96. 147592638 × 492
97. ———— × 453
98. ———— × 566
99. 312759846 × 577
100. 438267915 × 688
101. 582976134 × 709
102. ———— × 345
103. ———— × 749
104. 718293645 × 947
105. ———— × 753
106. ———— × 897

Find the sum of the squares, or cubes (as indicated) of the following:—*

1.	2.	3.	4.	5.	6.	7.	8.
412^3	325^2	432^3	543^2	123^3	657^3	373^3	654^3
214^2	532^3	543^2	645^3	219^2	709^3	494^2	565^2
142^3	453^3	536^2	564^2	832^2	765^3	607^3	678^2
253^2	435^3	365^2	203^3	725^3	464^2	476^3	787^2
352^3	524^3	654^2	405^2	501^3	908^3	675^3	232^3

---

* For each of these sums the pupil should be allowed to count five.

9.	11.	13.	* 15.	17.	19.	21.	23.
765^2	789^2	528^3	318^3	897^3	486^3	692^3	465^3
543^2	765^2	281^3	429^3	715^3	965^3	859^3	352^3
781^2	787^2	831^3	956^3	523^3	521^3	372^3	794^3
567^2	979^2	136^3	687^3	361^3	798^3	739^3	681^3
452^2	567^2	367^3	713^3	256^3	800^3	619^3	593^3

10.	12.	14.	16.	18.	20	22.	24.
898^2	937^2	749^3	317^3	693^3	830^3	765^3	786^3
876^2	848^2	496^3	787^3	843^3	312^3	468^3	543^3
954^2	769^2	967^3	865^3	377^3	205^3	257^3	372^3
495^2	670^2	678^3	594^3	304^3	470^3	913^3	899^3
203^2	840^2	731^3	424^3	500^3	648^3	928^3	987^3

Let B. be taken from A. as often as possible. There should not be a remainder at any of the sums.

	A.	B.
1.	74050	7405
2.	56390	5639
3.	27180	2718
4.	83540	8354
5.	67080	6708
6.	324510	32451
7.	697820	69782
8.	675430	67543
9.	678950	67895

LONG DIVISION.

1. 678604÷21
2. ———÷31
3. ———÷41
4. ———÷51
5. 875640÷61
6. ———÷71
7. ———÷81
8. ———÷91
9. 1003005÷22
10. ———÷32
11. ———÷42
12. ———÷44
13. 7008605÷54
14. ———÷65*
15. ———÷56
16. ———÷64
17. 246813579÷ 76
18. 740440737÷ —
19. 137592648÷ 87
20. 412777944÷ —
21. 319752864÷ 88
22. 959258592÷ —
23. 128953674÷ 96
24. 386861022÷ —
25. 9283746÷605
26. ———÷706
27. ———÷807
28. ———÷808
29. 408518488÷ 98
30. ———÷ 97
31. ———÷ 89
32. ———÷ 99
33. 413327139÷232
34. ———÷345
35. ———÷435
36. ———÷565
37. 623711453÷——
38. ———÷743
39. ———÷766
40. ———÷432
41. 172436661÷——
42. ———÷543
43. ———÷654
44. ———÷764
45. 674925420÷——
46. ———÷465
47. ———÷547
48. ———÷678

---

* When the second figure from the left hand is 5, or more than 5, suppose the first figure *one more* than it really is in finding the trial quotient figure.

To be proved by Multiplication.

49. 134217728÷512
50. 135005697÷513
51. 135796744÷514
52. 136590875÷515
53. 137388096÷516
54 138188413÷517
55. 139798359÷519
56. 246491883÷627
57. 247673152÷628
58. 259694072÷638
59. 395446904÷734
60. 408518488÷742
61. 415160936÷746
62. 433798093÷757
63. 440711081÷761
64. 636056000÷860
65. 676836152÷878
66. 603351125÷845
67. 609800192÷848
68. 700227072÷888
69. 724150792÷898
70. 339807409 19÷3239
71. 37528080192÷3348
72. 38751727104÷3384
73. 42581671488÷3492
74. 88299467677÷4453
75. 172436661496÷5566
76. 284500822033÷6577
77. 299149852672÷6688
78. 301976658829÷6709
79. 396255588625÷7345
80. 190010204749÷5749
81. 121066986123÷4947
82. 190407092777÷5753
83. 197849544283÷5827
84. 305773357553÷6737
85. 413327139849÷7449
86. 623711453184÷8544
87. 674295420609÷8769
88. 681239706399÷8799
89. 965309068387÷9883
90. 969417177273÷9897

91. 43980740900÷ 3400
92. 93370896000÷ 45000
93. 7683930000÷560000
94. 9739894000÷670000
95. 4987654300÷780000
96. 7654345670÷890000
97. 305773357553÷ 4970
98. ————————÷ 75500

Multiply A and B together, and divide their product by C.

	A.	B.	C.
1.	24755	32	21
2.	74283	23	31
3.	52582	43	41
4.	38877	34	51
5.	83969	45	61
6.	36839	54	71
7.	86972	63	81
8.	99297	56	22
9.	36674	64	33
10.	76567	73	43
11.	85875	65	44
12.	67685	75	54
13.	39745	69	65
14.	67875	232	56
15.	68857	343	64
16.	68388	454	76
17.	88389	565	76
18.	33458	432	87
19.	27673	543	87
20.	77449	654	88
21.	27458	676	88
22.	87524	667	96
23.	58396	787	96
24.	93856	788	605
25.	13578	954	706
26.	53187	876	808

	A.	B.	C.		A.	B.	C.
27.	83517	232	98	37.	986661852	348	761
28.	86249	343	97	38.	719648282	384	860
29.	92486	454	89	39.	486826484	492	878
30.	987654321	643	627	40.	228316932	429	3329
31.	125436789	643	928	41.	873675355	453	3248
32.	975318642	465	638	42.	775573375	534	3384
33.	682479135	565	734	43.	975386139	566	3492
34.	468257913	673	742	44.	378241977	688	4453
35.	468235791	673	746	45.	252686428	709	5566
36.	993149155	239	757	46.	331916387	907	6577

	A.	B.	C.		A.	B.	C.
47.	33980	$23\frac{2}{3}$	67	51.	763248995	$32\frac{3}{4}$	343
48.	74919	$34\frac{3}{4}$	78	52.	440876598	$43\frac{7}{8}$	454
49.	87528	$45\frac{4}{5}$	89	53.	438797736	$54\frac{2}{7}$	667
50.	80192	$56\frac{5}{6}$	90	54.	554433254	$65\frac{5}{9}$	788

SECOND PREPARATORY EXERCISE.—*Part Third.*

Take the number formed by every two figures of the rows at page eight, and say what number added to it will make the number next above it, the unit's place of which is indicated by the next figure of the row; thus, the first two figures of the first row make 94—the next two, 47—and the next, 76. Now, the pupil is to say what number added to 94 will make 97, which is the number next above 94, whose unit's place is 7, the next figure of the row. Then he will take the next number, 47, and say what number added to it will make 56, 56 being the number next above 47, the unit's place of which is 6, the next figure of the row; and so on to the end of the row, and with each succeeding one.

55. 7608—(523+768+365+98+75) without first finding the *sum* of the numbers to be subtracted.
56. 65084—(6784+6230+5485+263+563)
57. 739006—(65301+73005+12735+60810)
58. 792638—(563+7988+3071+6584+30076+25507)
59. 798631—(367+75+9384+67853+35791+57319)

How to find certain Common Measures and the *greatest* Common Measure of two numbers. Any number that will divide *two* or *more* numbers without a remainder, is called a Common Measure; and the largest number that will do so is called the Greatest Common Measure.

Contraction—G. C. M.

Two Nos. will measure by 10, when they both end in one cipher, and by 100, when they both end in two ciphers.

—————————— by 5, when the unit's place in both is either a cipher or a 5.

—————————— by 2, when the unit's fig. in each is measured by 2.

—————————— by 4, when the tens and units in each is measured by 4.

—————————— by 8, when the hundreds, tens, and units, is measured by 8.

—————————— by 9, when the sum of the digits of each is measured by 9.

—————————— by 3, when the sum of the digits of each is measured by 3.

—————————— by 6, when the sum of the digits of each is measured by 3, and the unit's place by 2.

—————————— by 11, when the sum of the alternate figures are equal, or when the one sum exceeds the other by 11 or a multiple of 11.

To find the G. C. M.—Divide the greater number by the lesser, and this divisor by the remainder, and continue to divide the last divisor by the last remainder until nothing remains—the last divisor is the G. C. M. of the two numbers.

Find the G. C. M. of A. and B.

	A.	B.		A.	B.		A.	B.
1.	44	52	25.	5795	20069	49.	18758	19594
2.	115	265	26.	2438	3127	50.	352087	386461
3.	216	232	27.	2250	2439	51.	476929	483241
4.	246	522	28.	4958	6231	52.	15151	19321
5.	216	424	29.	5325	5822	53.	14641	24079
6.	369	783	30.	1295	1591	54.	637818	1530144
7.	243	261	31.	1763	2279	55.	1283745	1838405
8.	115	200	32.	5475	5986	56.	202022	427371
9.	49	133	33.	3780	4374	57.	308385	1390455
10.	187	473	34.	2525	2825	58.	2938360	18574745
11.	88	296	35.	8250	9141	59.	6386688	12030336
12.	253	319	36.	6138	4884	60.	11513407	27621216
13.	104	296	37.	5992	5040	61.	44975438	54559902
14.	45	207	38.	35657	37863	62.	19070301	42370149
15.	204	492	39.	7979	8927	63.	12611668	13348564
16.	253	583	40.	18500	20498	64.	32696427	46825923
17.	250	263	41.	214369	228722	65.	16163434	18291504
18.	420	564	42.	247009	252973	66.	85968	138240
19.	300	564	43.	71289	81969	67.	173760	281817
20.	403	767	44.	55986	63714	68.	90906	889440
21.	780	4260	45.	244036	228722	69.	397035	641835
22.	182	221	46.	94249	81969	70.	734964	1924572
23.	184	805	47.	252973	259081	71.	2168439	2996532
24.	250	269	48.	1548	648	72.	29622558	46348638

QUESTIONS TO BE ANSWERED BY THE PUPILS.

1. What is meant by the *sum* of two numbers?
2. What is meant by the word additive?
3. What is meant by the difference of two numbers?
4. What is meant by the minuend and subtrahend?
5. What is meant by the product of two numbers?
6. What is meant by the *continued* product of several numbers?
7. What is the meaning of the words multiplicand and multiplier?
8. How do you multiply by such a fraction as $\frac{1}{5}$?
9. How do you multiply by such a fraction as $\frac{4}{5}$?
10. How do you multiply by such a fraction as $\frac{3}{5}$?
11. What is the meaning of the words dividend and divisor?
12. What is the meaning of the word quotient?
13. If you multiply the divisor and quotient together, with what number should the product agree?
14. If you divide the product of two numbers by one of them, with which should the quotient agree?
15. How do you divide when the divisor contains a fraction?
16. What is the meaning of notation and numeration?
17. What is meant by the digits and cipher?
18. How many ciphers are necessary to express millions?

19. What is the short way for dividing a number by ten?
20. How do you multiply by a hundred?
21. How do you divide by a thousand?

MULTIPLICATION AND DIVISION, WITH A FRACTION COMBINED.

1. $3107 \times 5\frac{1}{2} \div 3\frac{1}{2}$
2. $7036 \times 4\frac{2}{3} \div 1\frac{2}{3}$
3. $7631 \times 10\frac{1}{4} \div 1\frac{1}{4}$
4. $3456 \times 9\frac{4}{5} \div 1\frac{1}{5}$
5. $7899 \times 7\frac{1}{6} \div 1\frac{1}{6}$
6. $6053 \times 8\frac{6}{7} \div 1\frac{6}{7}$
7. $3579 \times 6\frac{1}{5} \div 2\frac{3}{5}$
8. $2468 \times 3\frac{3}{4} \div 1\frac{3}{4}$
9. $2397 \times 11\frac{1}{2} \div 3\frac{1}{2}$
10. $6573 \times 12\frac{5}{7} \div 1\frac{5}{7}$
11. $5307 \times 15\frac{4}{7} \div 3\frac{1}{7}$
12. $5360 \times 18\frac{4}{5} \div 2\frac{3}{5}$
13. $5803 \times 27\frac{7}{11} \div 2\frac{1}{11}$
14. $7998 \times 45\frac{6}{7} \div 1\frac{3}{7}$
15. $6040 \times 54\frac{2}{3} \div 3\frac{2}{3}$
16. $9768 \times 64\frac{1}{4} \div 2\frac{3}{4}$
17. $4504 \times 63\frac{3}{4} \div 5\frac{1}{4}$
18. $1730 \times 72\frac{1}{6} \div 1\frac{5}{6}$
19. $7799 \times 71\frac{5}{6} \div 8\frac{1}{6}$
20. $2438 \times 81\frac{2}{3} \div 4\frac{2}{3}$
21. $6395 \times 25\frac{1}{7} \div 2\frac{4}{7}$
22. $4763 \times 50\frac{1}{2} \div 3\frac{1}{2}$
23. $8179 \times 49\frac{1}{8} \div 10\frac{1}{8}$
24. $7251 \times 55\frac{2}{3} \div 11\frac{2}{3}$
25. $5635 \times 32\frac{3}{4} \div 15\frac{3}{4}$
26. $3517 \times 41\frac{5}{6} \div 5\frac{5}{6}$
27. $2345 \times 42\frac{1}{2} \div 4\frac{1}{2}$
28. $3456 \times 31\frac{2}{3} \div 5\frac{1}{5}$
29. $4567 \times 55\frac{1}{4} \div 6\frac{1}{4}$
30. $5678 \times 27\frac{4}{5} \div 7\frac{1}{5}$
31. $6789 \times 65\frac{1}{6} \div 8\frac{1}{6}$
32. $7890 \times 76\frac{6}{7} \div 9\frac{1}{7}$
33. $7678 \times 80\frac{1}{8} \div 10\frac{1}{8}$
34. $6567 \times 20\frac{7}{8} \div 10\frac{1}{8}$
35. $5432 \times 40\frac{3}{8} \div 12\frac{3}{8}$
36. $6543 \times 50\frac{4}{7} \div 9\frac{1}{7}$
37. $7654 \times 60\frac{3}{8} \div 7\frac{7}{8}$
38. $8765 \times 79\frac{7}{9} \div 8\frac{5}{9}$
39. $9876 \times 80\frac{2}{11} \div 4\frac{5}{11}$
40. $8907 \times 39\frac{5}{12} \div 4\frac{8}{12}$
41. $8760 \times 29\frac{3}{4} \div 6\frac{1}{4}$
42. $7656 \times 60\frac{1}{20} \div 3\frac{3}{20}$

SIMPLE DIVISION.

A common multiple of two or more numbers is a number which may be divided by each of the others without remainder, and the least number which can be so divided is their least common multiple.

How to find the Least Common Multiple, or Least Common Product of two or more numbers.

Contraction—L. C. M.

When the numbers are prime to each other their product is their Common Multiple.

(1) 2 5 21. (2) 5 7 9. (3) 9 8 11. (4) 13 11 6
(5) 9 26 7 5. (6) 29 14 13 11. (7) 8 5 7 11.
(8) 5 7 12 13.

When two or more of the numbers have a Common Measure, write them in a line, and cancel any that any of the others contain, then divide those not cancelled by any small number which will divide two or more of them without remainder, write the quotients and the *numbers not divided* in a line beneath the former, cancel as before, and divide the numbers in this line in the same way, and continue the process until all of the numbers are prime to each other, then multiply those numbers and the divisors together for the L. C. M.

EXAMPLE—Find the L. C. M. of—

$$\begin{array}{r|l} 5 & \cancel{12}, 10, 24, 15, 36, \cancel{8}, \cancel{18} \\ \hline 12 & \cancel{2}, 24, \cancel{3}, 36 \\ \hline & \quad 2 \qquad 3 \end{array}$$

2×3×5×12=360 the L. C. M.

9.	2	3	4
10.	10	20	5
11.	3	18	2
12.	2	4	6
13.	12	3	8
14.	3	21	7
15.	4	12	6
16.	4	6	8
17.	15	10	3
18.	2	32	8
19.	5	30	3
20.	8	4	12
21.	5	15	10
22.	5	30	6
23.	15	60	6
24.	6	8	10
25.	12	6	7
26.	4	10	6
27.	6	10	12
28.	6	7	3
29.	6	8	9
30.	3	9	8
31.	8	10	15
32.	8	12	16
33.	4	13	2
34.	12	14	3
35.	6	7	18
36.	8	48	3
37.	10	12	9
38.	18	12	4
39.	15	18	3
40.	4	28	21
41.	8	16	20
42.	6	15	18
43.	7	28	5
44.	12	16	20

45.	3	4	6	8
46.	3	5	6	10
47.	3	4	9	12
48.	8	3	6	4
49.	5	7	2	10
50.	6	8	9	12
51.	9	6	5	3
52.	6	9	12	8
53.	2	6	9	10
54.	4	6	9	6
55.	2	5	3	4
56.	4	6	5	9
57.	4	16	18	9
58.	9	2	3	10
59.	8	12	16	18
60.	16	12	6	9
61.	3	4	7	12
62.	9	12	16	24
63.	15	20	30	40
64.	12	16	24	32
65.	18	24	36	48
66.	6	10	12	20
67.	12	36	27	9
68.	14	24	36	24
69.	20	15	30	90
70.	24	36	54	48
71.	18	24	72	54
72.	25	30	40	60
73.	27	36	81	108
74.	6	8	18	24
75.	30	36	48	108
76.	21	35	42	70
77.	35	42	56	84
78.	42	63	84	126
79.	18	45	27	36
80.	35	21	42	28

81.	30	40	45	60
82.	30	45	60	90
83.	16	40	24	32
84.	40	24	48	32
85.	42	56	63	84
86.	12	18	24	36
87.	10	25	15	20
88.	30	18	36	24
89.	54	72	81	108
90.	36	54	72	108
91.	6	15	9	12
92.	20	12	24	16
93.	18	24	27	36
94.	16	24	40	48
95.	15	21	6	30
96.	40	60	30	90
97.	6	9	15	18
98.	45	63	18	90
99.	48	72	36	108
100.	35	49	14	70
101.	32	48	24	72
102.	14	21	35	42
103.	10	14	4	20
104.	16	24	12	36
105.	16	48	72	80
106.	12	36	54	60
107.	81	54	45	27
108.	24	96	108	54
109.	112	84	42	63
110.	24	36	30	54
111.	28	42	35	63
112.	36	144	162	81
113.	32	48	40	72
114.	36	54	45	81
115.	72	48	40	24
116.	128	96	48	72

FIRST EXERCISE ON THE TABLES OF WEIGHTS AND MEASURES, AND IN REDUCTION.

Money.

4 farthings = 1 penny.
12 pence = 1 shilling.
20 shillings = 1 pound.

Avoirdupois Weights.

The Quarter, the Hundred Weight, and the Ton.

4 quarters = 1 hundred weight.
20 hundred weights = 1 ton.

Troy Weights.

The Pennyweight, Ounce, and Pound.

20 pennyweights = 1 ounce.
12 ounces = 1 pound.

Measures of Capacity for Liquids.

A Pint, a Quart, a Gallon.

2 pints = 1 quart.
4 quarts = 1 gallon.

Measures of Capacity for Grain, &c.

The Peck, the Bushel, the Quarter.

4 pecks = 1 bushel.
8 bushels = 1 quarter.

Measures of Length.

The Furlong, the Mile, the League.

8 furlongs = 1 mile.
3 miles = 1 league.

Measures of Surface for Land.

The Perch, the Rood, the Acre.

40 perches = 1 rood.
4 roods = 1 acre.

Measures for all kinds of Cloth.

The Nail, the Quarter, the Yard.

4 nails = 1 quarter.
4 quarters = 1 yard.

Measures of Time.

The Minute, the Hour, the Day,

60 minutes = 1 hour.
24 hours = 1 day.

Divisions of every Circle.

The Second, the Minute, the Degree.

60 seconds = 1 minute.
60 minutes = 1 degree.

FIRST REDUCTION EXERCISES.*

Money.

1. Reduce 756 pence to farthgs.
2. " 5467 pence to shilgs.
3. " 765 pounds to shilgs.
4. Reduce 4672 farthgs. to pence.
5. " 865 shilgs. to pence.
6. " 4765 shilgs. to pounds.

Avoirdupois Weights.

7. Reduce 721 tons to cwt.
8. " 5408 qrs. to cwt.
9. Reduce 1568 cwt. to tons.
10. " 806 cwt. to qrs.

Troy Weights.

11. Reduce 7530 oz. to lbs.
12. " 562 oz. to dwt.
13. Reduce [illegible]83 lbs. to oz.
14. " 12345 dwt. to oz.

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* The object aimed at in these exercises, is to teach the pupil when he is to multiply and when to divide, by considering whether the *number* of the answer is to be greater or less than that given.

Measures of Capacity for Liquids.

15. Reduce 236 gals. to quarts.
16. " 6785 quarts to gals.
17. Reduce 632 quarts to pints.
18. " 7576 pints to quarts.

Measures of Capacity for Wheat, Potatoes, &c.

19. Reduce 375 bushels to qrs.
20. " 35097 do. to pecks.
21. Reduce 958 pecks to bushls.
22. " 438 qrs. to do.

Measures of Length.

23. Reduce 739 leagues to miles
24. " 5970 miles to leagues
25. Reduce 5000 frlngs. to miles.
26. " 987 miles to frlngs.

Measures of Surface for Land.

27. Reduce 8508 roods to acres.
28. " 537 acres to roods.
29. Reduce 951 roods to prchs.
30. " 98760 prchs. to roods.

Measures of Cloth.

31. Reduce 769 quarters to nails.
32. " 4508 quarters to yds.
33. Reduce 2030 nails to qrs.
34. " 576 yards to qrs.

Measures of Time.

35. Reduce 678900 mts. to hours.
36. " 9876 hours. to mts.
37. Reduce 6183 days to hours.
38. " 46786 hours to days.

Measures of Solids.

39. Reduce 965479 inches to feet.
40. " 68705 feet to yards.
41. Reduce 378 feet to inches.
42. " 809 yards to feet.

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43. How many farthings are equal to 430 half-pence?
44. ———— half-pence ———— 346 pence?
45. ———— half-crowns ———— 5005 crowns?
46. ———— shillings ———— 2486 sixpences?
47. ———— quarts ———— 7834 pints?
48. ———— pecks ———— 4378 gallons?
49. ———— yards ———— 7815 feet?
50. ———— leagues ———— 5187 miles?
51. ———— fourpences. ———— 8157 shillings?
52. ———— shillings ———— 9634 threepences?
53. ———— quarters ———— 4939 yards?
54. ———— roods ———— 7984 acres?
55. ———— pints ———— 9748 gills?
56. ———— quarts ———— 3456 gallons?
57. ———— hundred weights ———— 3248 quarters?
58. ———— threepences ———— 7424 shillings?
59. ———— pounds sterling ———— 3456 half-crowns?
60. ———— bushels ———— 9738 quarters?

61. How many miles are equal to 579 leagues?
62. ——— shillings ——— 745 crowns?
63. ——— hours ——— 79 days?
64. ——— days ——— 15648 hours?
65. ——— pounds avoirdupois ——— 56 quarters?
66. ——— hundred weights ——— 452 tons?
67. ——— quarters ——— 1260 hundred wts.?
68. ——— tons ——— 1500 hundred wts.?
69. ——— degrees ——— 3600 minutes?
70. ——— days ——— 10 common years?

If the teacher thinks it desirable, the pupil may now proceed to the compound rules.—(See Preface.)

Weights and Measures.

Money.

4 farthings = 1 penny.
12 pence = 1 shilling.
2 shillings = 1 florin.
5 shillings = 1 crown.
20 shillings, 10 florins or 4 crowns, } = 1 sovereign or pound.
21 shillings = 1 guinea.

Measures of Weight.

Avoirdupois Weight.

16 drams = 1 ounce = 437 grs.
16 ounces = 1 pound = 7000 —
14 pounds = 1 stone.
28 pounds = 1 quarter (qr).
4 quarters or 112 pounds } = 1 hundredwgt. (cwt).
20 cwt. = 1 ton.

This weight is used in the common dealings of life.

Troy Weight.

24 grains = 1 pennyw^{t} = 24 gr.
20 pennyw^{ts} = 1 ounce = 480 "
12 ounces = 1 pound = 5760 "

Used for weighing gold, silver, and precious stones (except diamonds*). Apothecaries use Troy weight in compounding medicines; but they divide the ounce into 8 drachms, and the drachms into 3 scruples, and the scruple into 20 grains.

Measures of Length.

12 inches = 1 foot.
3 feet = 1 yard.
5½ yards = 1 pole or rod.
220 yards or 40 poles } = 1 furlong.
8 furlongs = 1 mile.
$69\frac{1}{51}$ miles = { 1 deg. of a great circle of the earth †
A nail = 2¼ inches
A quarter = 4 nails
A yard = 4 qrs.
An Eng. ell = 5 qrs.
A French ell = 6 qrs.
A Flemish ell = 3 qrs. } cloth measures
A fathom = 6 ft. used in measuring depths.
A link = 7·92 in.
A chain = 100 links } used in land measure.

* The carat used in weighing diamonds, is 3⅙ Troy grains.

† In the Reduction exercises reckon 69 miles to the degree.

MEASURES OF SURFACE.

144 sq. inches=1 sq. foot.
9 sq. feet =1 sq. yard.
30¼ sq. yards =1 sq. pole or perch
40 perches =1 rood.
4 roods =1 acre.
10 sq. chains=1 acre.
640 acres =1 square mile.

MEASURES OF SOLIDITY AND CAPACITY.

Solidity.

1728 cubic inches=1 cubic foot.
27 — feet=1 cubic yard.
5 — feet=1 barrel bulk.
42 — feet=1 ton of shippg.
40 — feet of rough, or 50 cubic feet of hewn timber = 1 load.

Capacity.

4 gills =1 pint, 34⅔ cub. inch. [nearly.
2 pints =1 quart, 69⅓ ——
4 quarts =1 gallon, 277¼ ——
2 gallons=1 peck, 554½ ——
4 pecks =1 bushel, 2218⅕ ——

Capacity—continued.

8 bushels=1 quarter, 10¼ cub.feet [nearly.
5 quarters=1 load, 51⅓ ——

DIVISIONS OF THE CIRCLE.

60 seconds = 1 minute.
60 minutes = 1 degree.
30 degrees = 1 sign.
90 —— = 1 quadrant.
360 do. or 12 signs=1 circumference.

MEASURES OF TIME.

60 seconds = 1 minute.
60 minutes = 1 hour.
24 hours = 1 day.
7 days = 1 week.
28 days = 1 lunar month.
28, 29, 30, or 31 days = 1 calendar month.
12 calendar months = 1 year.
365 days = 1 common year.
366 days = 1 leap year.
In 400 years, 97 are leap years and 303 common.

Hp. to pnc.
1. 4754
2. 9103

Far. to pnc.
3. 63195
4. 72807

Pen. to shil.
5. 479813
6. 356915
7. 170937

Shl. to pnds.
8. 60173
9. 38471

Hp. to shils.
10. 79561
11. 82375
12. 63471
13 39597

Far. to shils.
14. 34567
15. 89246
16. 35791
17. 82465

Pnc. to pnds.
18. 765489
19. 379814

Pnc. to pnds.
20. 5011637
21. 6101357
22. 294583
23. 719238

Hp. to pnds.
24. 777555
25. 9944411
26. 6103892
27. 787565
28. 345678
29. 987654
30. 294765

Far. to pnds.
31. 721053
32. 602140
33. 860642
34. 236091
35. 521271
36. 615684
37. 681181

Shil. to farth.

	s.	d.
38. 2765		
39.	35	10¾
40.	247	11½
41.	361	11¾

Pounds to pence.

	L.	s.	d.
42.	4678	0	0
43.	146	17	3
44.	34	17	9
45.	29	18	5
46.	67	17	7

Pounds to farth.

47.	3498	0	0
48.	345	1	10¼
49.	453	11	7¾
50.	641	11	7¼
51.	297	0	8¾
52.	951	19	11¼

Qrs. to lbs.

53. 763 qr.
54. 751 qr. 14 lbs.
55. 398 qr. 23 lbs.
56. 645 qr. 27 lbs.

Cwt. to lbs.

57. 42 cwt. 1 qr. 23 lbs.
58. 12 cwt. 3 qrs. 25 lbs.
59. 96 cwt. 1 qr. 10 lbs.
60. 82 cwt. 15 lbs.
61. 73 cwt. 3 qrs.
62. 868 cwt. 20 lbs.
63. 737 cwt. 1 qr. 2 lbs.

Tons to lbs.

	Tons.	Cwt.	Qrs.	Lbs.
64.	599	3	2	25
65.	602	14	0	8
66.	613	6	3	4
67.	616	18	1	0
68.	312	0	0	27

Lbs. to drs.

69. 364 lbs.
70. 78 lbs. 11 oz. 6 dr.
71. 61 " 0 " 13 "
72. 59 " 10 " 0 "

Cwt. to oz.

73. 567 cwt.
74. 38 cwt. 2 qrs. 15 lbs.
75. 87 " 3 " 27 "
76. 69 " 1 qr. 15 oz.

Lbs. to qrs.

77. 177191
78. 355000
79. 642464
80. 555777
81. 699113
82. 911639
83. 821818
84. 838427

Lbs. to cwt.

85. 33333
86. 7654
87. 3131
88. 79790
89. 3761
90. 300700
91. 611711
92. 713280
93. 637300
94. 97654
95. 73281
96. 721031
97. 130127
98. 60705
99. 65070
100. 57533
101. 53337
102. 71913
103. 56111
104. 71222
105. 83333
106. 94444
107. 78555

Drs to lbs.

108. 603004
109. 731982
110. 657896
111. 795686
112. 767635

Oz. to cwt.

113. 65430
114. 70771
115. 34569
116. 78901
117. 19087
118. 65735

Ounces.

119. 76513 to lbs.
120. 48379 —
121. 94763 —
122. 18254 —
123. 96731 to qr.
124. 85242 —
125. 95687 —
126. 13317 —
127. 86594 to cwt.
128. 24897 —
129. 15236 —
130. 12569 —
131. 84377 —
132. 34896 to tons.
133. 52112 —
134. 56984 —
135. 27983 —
136. 12456 —

137. Reduce £75 7
138. Reduce £89 9
139. Reduce £91 5
florins to florins.

140. Reduce 7531
141. Reduce 6473
142. Reduce 9711
florins to pounds.

Furlongs to Miles.

143. 711311
144. 597977

Yards to Furlongs.

145. 376081
146. 803762
147. 517171
148. 792872

Yards to Miles.

149. 72916
150. 31853
151. 79197
152. 78297
153. 71715
154. 67308
155 80672

Miles to Degrees.

156. 733117
157. 517193
158. 456654

Yards to Degrees.

159. 462979
160. 381657
161 497755

Miles to Yards.

162. 798 miles.
163. 536 miles 3 furlongs.
164. 25 miles 3 furlgs. 211 yds.

Degrees to yards.

165. 45 degrees 27 yards.
166. 69 deg. 3 furlongs 140 yds.
167. 18 deg. 17 miles 6 furlongs.

Yards.

168. 897136 to furlongs.
169. 523612 to miles.
170. 569843 to degrees.
171. 773489 to furlongs.
172. 652112 to miles.
173. 569843 to degrees.
174. 798312 to miles.

Acres to Poles.

175. 37 acres 1 rood 29 poles.
176. 63 acres 3 roods 37 poles.
177. 59 acres 2 roods 31 poles.

Poles to Yards.

178. 215 poles 17 yards.
179. 246 poles 13½ yards.
180. 654 poles 24¾ yards.

Acres to Yards.

181. 3 acres 15 poles 15 yards.
182. 27 acres 3 roods 23 yards
183. 16 acres 1 rood 39 poles.
184. 84 acres 29 yards.
185. 79 acres 14 poles.
186. 68 acres 1 rood 3 poles.
187. 45 acres 31 poles 29½ yards

Poles to Acres.

188. 69843
189. 79837

Yards to Poles.

190. 496731
191. 852249
192. 568713
193. 887924

Yards to Acres.

194. 6928537
195. 27395
196. 19754
197. 6825791
198. 31983
199. 927436
200. 513527

Acres.

201. 54 acres 3 roods to roods.
202. 63 acres 5 poles to poles.
203. 71 acres 1½ yards to yards.

Yards.

204. 98216 to poles.
205. 53491 to roods.
206. 82736 to acres.

207. How many stones are in 27 cwt. 3 qrs. 15 lbs.?
208. How many stones are in 371 cwt. 1 qr. 17 lbs.?
209. How many half pounds are in 1 cwt. 3 qrs. 1 lb.?
210. How many half ounces are in 2 qrs. 17½ lbs.?
211. How many sections, of 60 perches each, may be made out of a piece of land measuring 5 ac. 2 ro. 30 po ?
212. How many days are there from the 12th of August to the 30th of September?
213. How many days are there from the 7th of March to the 28th of November?
214. How many days are there from the 11th of November to the 25th of May?

215. How many days are there from the 5th of April, 1848, to the 17th of March, 1849?
216. How many days are there from the 7th of July, 1849, to the 7th of May, 1850?
217. Reduce 31 guineas 17s 11¾d and £715 11s 11½d to farthings.
218. ——— 25 cwt. 1 qr. 23 lbs. and 31 cwt. 2 qrs. 19 lbs. 1 dr. to drams.
219. ——— 18 lbs. 15 dwt. 17 gr. and 25 oz. 17 dwt. 1 gr. to grains.
220. ——— 19 lbs. 11 oz. 5 drs. and 23 lbs. 2 oz. 3 drs. 1 sc. 17 gr. to grains.
221. ——— 5 yds. 1 qr. 3 nls. and 5 Eng. ells 1 qr. 3 nls. to nails.
222. ——— 7 m. 3 fur. 210 yds. 1 ft. and 12 m. 7 fur. 116 yds. 2 ft. to feet.

223. £456 to pence.
224. £673 13 5 — farthings.
225. £736 0 0½ — halfpence.
226. 777 gallons — pints.
227. 979 do. — gills.
228. 206 do. — bushels.
229. 30000 do. — quarters.
230. 2546 farthings — shillings.
231. 94275 do. — pounds.
232. 45689 poles — miles.
233. 98654 do. — leagues.
234. 9 signs — minutes.
235. 11 do. — seconds.
236. 775 quarters — pecks.
237. 86 quarters to gallons.
238. 979 leagues — furlongs.
239. 298 do. — poles.
240. 8765 dr. avoir. — lbs.
241. 98760 do. — qrs.
242. 70000 do. — cwt.
243. 756 tons. — qrs.
244. 97 do. — lbs.
245. 4010 sq. yards — roods.
246. 47860 do. — acres.
247. 79 ounces — tons.
248. 44 do. — do.
249. 7568 grains — oz.
250. 65000 do. — lbs.

251. 273 shillings to fivepences.
252. 700 fivepences to shillings.
253. 27s 9d to ninepences.
254. 600 ninepences to shillings.
255. 351s 5d to sevenpences.
256. 500 fivepences to pounds.
257. 417 shillings to eightpences
258. 450 eightpences to seven-shilling-pieces.
259. 730 fourpences to sixpences.
260. 370 yards to ells.
261. 678 Eng. ells to yards.
262. 876 French ells to Eng. ells.
263. 678 Eng. ells to Flmsh. ells
264. 468 do. to yards.
265. 6781 cubic inches to gals.
266. 876 half-guineas to crowns.
267. 890 crowns to half-guineas.
268. 875 pounds to guineas.
269. 965 do. do.
270. 596 guineas to pounds.
271. 976 do. do.
272. 4500 geog. miles to Bt. do.*
273. 7968 do. do.
274. 8697 Brt. miles to geog. do.
275. 4005 do. do.

*To reduce geo. miles to British miles, multiply by 69 and divide by 60. To reduce British miles to geo. miles, multiply by 60 and divide by 69.

Reduce to the same denomination.

276. £18 6s 3d, and £1 10s 11d
277. 10 guineas and £24 5s 7d
278. £7 7s 6½d and £17 15s 11¾d
279. 6 crowns and £13 0s 0½d.
280. 7 yards 1 qr and 13 yards.
281. 13 yds. 2 qrs. & 3 yds. 3 nls.
282. 25 yards and 22 Eng. ells.
283. 65 Frnch. ells & 56 Eng. do.
284. 3 qts. 2 pts. and 4 gls. 2 qts.
285. 1 gallon and 1 quart 1 gill.
286. 3 qrs. 7 bush. and 10 qrs. 5 bush. 3 pecks.
287. 10 days 15 min. and 25 days
288. 8 miles, 3 fur. and 25 fur. 15 poles.
289. 15 ac. 1 rd. and 27 ac. 13 po.
290. 75 ac. and 11 ac. 24 po. 3 yd.
291. 16 a. 3 p. and 3 rd. 29½ yds.
292. 1 lb. 5 oz. 10 dwt. and 15 oz. 1 dwt.
293. 2 lbs. 3 dwt. and 1 oz. 2 dwt. 21 gr.
294. 15s 9¾d and £2 0s 0¾d.
295. 16 days 16 minutes and 20 days 20 seconds.
296. 9 mls. 3 fur. & 30 fr. 179 yd.
297. 15 oz. 15 gr. & 1 lb. 15 dwt.
298. 8 sq. ft. and 11 sq. yds. 139 square inches.
299. 2 bush. 2 gal. & 3 qrs. 1 gal.
300. 3 cwt. 1 qr. and 6 qrs. 21 lbs.
301. 71 cwt. 3 qrs. 13 lbs. and 21 lbs. 15 oz.
302. 69 tns. 15 lbs. & 17 cwt. 1 oz.
303. 110½ oz. avor. & 22 lbs. 4 oz.
304. 3 gallons and 2 gills.
305. 1 qt. 1 pt. and 3 gal. 1½ gill.
306. 171 leagues, 1 inch, & 156 m.
307. 27 acres, 3 rd. 17 po. and 3 rd. 39½ poles.
308. 1 sq. mile and 17 ft. 2 in.
309. 7 wks. 5 ds. & Jan. Fb. Mch.
310. 365 d. 6 h. & 365 d. 5 h. 48′ 48″.
311. 87 da. 23 ho. 15 m. and 224 da. 16 ho. 49 m.
312. 1 yr. 321 d. 23 ho. 30 m. and 11 y. 317 d. 14 ho. 27 min.
313. 29 yrs. 174 da. 1 ho. 51 m. and 84 years 29 days.

COMPOUND REDUCTION.

PREPARATORY EXERCISE.

1. 341 at £2
2. 352 — 3
3. 456 — 4
4. 463 — 5
5. 517 — 9
6. 553 — 18
7. 375 — 19
8. 787 — 45
9. 789 — 78
10. 790 — 87
11. 845 — 2s
12. 854 — 4s
13. 863 — 6s
14. 872 — 8s
15. 873 — 10s
16. 879 at 12s
17. 897 — 14s
18. 950 — 3s
19. 957 — 5s
20. 965 — 7s
21. 967 — 9s
22. 968 — 11s
23. 973 — 13s
24. 935 — 15s
25. 1873 — 1d
26. 7871 — 1d
27. 9874 — 1d
28. 9706 — 1d
29. 5739 — 5d
30. 2353 — 5d
31. 5675 at 5d
32. 3565 — 7d
33. 5327 — 7d
34. 7537 — 7d
35. 6656 — 11d
36. 8763 — 11d
37. 8459 — ½d
38. 4588 — ½d
39. 7283 — ½d
40. 7388 — ½d
41. 7983 — ¼d
42. 9781 — ¼d
43. 9787 — ¾d
44. 9505 — ¾d
45. 9575 — ¾d
46. 9655 at ¾d
47. 9677 — ¾d
48. 6987 — ¾d
49. 731 — £13
50. 987 — 17s
51. 5329 — 9d
52. 6719 — ¾d
53. 781 — £35
54. 2353 — 8d
55. 897 — 17s
56. 7799 — ¾d
57. 798 — 17s
58. 976 — 5d
59. 4798 — £49
60. 989 — 17s

EXAMPLE.

Find the value of 431 yards, at £3 11s 4¾d.

```
            431
          £3  11  4¾
   4 | 1293
        328¼
       1724
  12 | 2047
        170   7
       4741
 2,0 | 491,1
       245  11
      1293
     £1538  11  7¼
```

FIRST SECTION.

61.	9731 at	£2	3	0		66.	7887 at	£5	9	0
62.	4327 —	4	6	0		67	8877 —	6	7	0
63.	3456 —	4	7	0		68.	5588 —	6	11	0
64.	5665 —	5	8	0		69.	7799 —	7	11	0
65.	6776 —	5	7	0		70.	7987 —	7	11	0

SECOND SECTION.

71. 135 at	£0	2	2	81. 928 at	£0	9	5	91. 519 at	£0	11	5
72. 352 —	0	3	2	82. 859 —	0	8	7	92. 197 —	0	12	7
73. 527 —	0	4	3	83. 593 —	0	7	7	93. 976 —	0	12	7
74. 546 —	0	5	3	84. 957 —	0	6	7	94. 765 —	0	13	5
75. 463 —	0	6	4	85. 372 —	0	5	7	95. 654 —	0	14	8
76. 637 —	0	7	5	86. 727 —	0	4	7	96. 468 —	0	15	8
77. 372 —	0	8	5	87. 273 —	0	3	7	97. 928 —	0	13	5
78. 297 —	0	9	5	88. 739 —	0	2	7	98. 837 —	0	15	7
79. 582 —	0	10	5	89. 395 —	0	11	5	99. 465 —	0	14	11
80. 692 —	0	10	5	90. 951 —	0	11	7	100. 651 —	0	13	7

THIRD SECTION.

101.	7536 at	1½d	111.	1234 at	11½d	121.	9173 at	2¾d
102.	6357 —	2½d	112.	5678 —	11¼d	122.	6826 —	1¾d
103.	7755 —	3½d	113.	6789 —	10¼d	123.	4264 —	11½d
104.	6886 —	4½d	114.	9753 —	9¼d	124.	2752 —	10¼d
105.	9731 —	5½d	115.	8186 —	8¼d	125.	9821 —	11¼d
106.	7319 —	6½d	116.	8642 —	7¼d	126.	7653 —	10¼d
107.	8246 —	7½d	117.	4297 —	6¼d	127.	6534 —	9¼d
108.	6375 —	8½d	118.	3579 —	5¾d	128.	2946 —	7¾d
109.	9876 —	9½d	119.	7924 —	4¾d	129.	5296 —	6¾d
110.	4432 —	10½d	120.	2468 —	3¾d	130.	3546 —	8¾d

Fourth Section.

131. 7121 at 1s 2½d
132. 9128 — 2s 3¼d
133. 739 — 3s 4½d
134. 8312 — 3s 4¾d
135. 391 — 4s 4½d

136. 6889 at 4s 5¼d
137. 6531 — 5s 6¾d
138. 8762 — 6s 7¼d
139. 5637 — 7s 9¾d
140. 9519 — 8s 10½d

141. 8128 at 9s 11¼d
142. 637 — 12s 8¼d
143. 378 — 13s 2¼d
144. 456 — 14s 6¼d.
145. 417 — 15s 8¼d

Fifth Section.

146. 654 at £2 3 5
147. 548 — 3 4 7
148. 371 — 4 3 7
149. 719 — 5 7 5
150. 798 — 5 7 7

151. 982 at £3 15 5
152. 956 — 7 13 7
153. 563 — 8 14
154. 596 — 6 17 5
155. 967 — 7 13 7

156. 567 at £7 10 5
157. 678 — 8 9 5
158. 342 — 10 7 5
159. 415 — 11 5 5
160. 712 — 11 8 7

Sixth Section.

161. 143 at £2 3 4¼
162. 324 — 1 5 7¼
163. 234 — 3 7 3½
164. 342 — 4 2 5¼
165. 432 — 5 4 6¼
166. 423 — 6 10 2½
167. 345 — 3 11 3¾
168. 354 — 4 12 4¼
169. 435 — 5 13 8¼
170. 453 — 6 14 9½
171. 534 — 10 1 7¾
172. 543 — 11 11 8¼
173. 456 — 10 2 6½
174. 465 — 7 12 7¾
175. 546 — 7 3 5¼
176. 564 — 7 7 6½
177. 645 — 8 10 4¾
178. 654 — 8 11 5½
179. 567 — 8 13 3¼
180. 573 — 9 3 4¾
181. 574 — 9 13 10¼
182. 575 — 9 4 9¼
183. 576 — 12 14 8¾
184. 675 — 12 5 6¼

185. 713 at £5 18 6¾
186. 928 — 8 9 6¾
187. 821 — 7 11 8¾
188. 397 — 9 7 9¾
189. 972 — 4 10 10½
190. 773 — 5 11 4½
191. 733 — 3 13 8¼
192. 792 — 5 3 8¼
193. 928 — 5 13 9¾
194. 657 — 5 4 9¾
195. 571 — 5 14 10¼
196. 739 — 7 5 9½
197. 938 — 9 15 8¾
198. 793 — 3 6 7¾
199. 931 — 9 16 6½
200. 579 — 7 7 6¼
201. 799 — 9 17 4¼
202. 979 — 7 18 5½
203. 756 — 13 18 7¾
204. 765 — 13 9 8¼
205. 677 — 14 10 9¾
206. 767 — 14 11 11½
207. 678 — 15 12 11¼
208. 687 — 16 13 10¼

COMPOUND ADDITION.

1		2		3		4		5		6	
£75	9	£325	10	£417	15	£915	11	£672	12	£345	7
89	4	647	12	625	11	729	8	726	9	45	11
27	10	297	8	849	12	891	15	989	19	729	15
38	11	715	5	751	9	647	6	377	2	87	17

7	8	9	10	11
£9 10 4	£18 11 7	£821 12 4	£ 77 13 9	£671 19 4
5 3 6	15 9 6	648 2 7	215 8 11	89 8 7
7 9 2	27 19 7	456 18 5	673 11 8	275 12 11
8 15 5	83 9 6	18 7 11	729 12 7	83 9 4
6 8 9	57 13 10	73 14 6	345 7 9	97 6 5

12	13	14	15
£372 7 11½	£937 8 3½	£778 10 4½	£375 6 2¾
457 10 7¾	526 18 11¾	629 7 11¾	476 9 11¼
568 8 2¼	674 5 8½	734 15 8¼	493 17 10¾
473 2 6¼	476 6 7½	374 4 10¼	284 14 7¾

16	17	18	19
£456 13 4½	£546 16 6¾	£654 13 11½	£654 18 10½
567 18 11¾	657 11 8½	756 15 9¾	765 19 7¾
678 11 3¾	768 17 11¾	867 17 7¼	876 13 11¾
895 16 8½	985 18 9½	957 19 11¾	975 16 9¾

20	21	22	23
£47 13 3	£87 9 6¾	£643 12 6	£472 4 9½
55 10 11	63 11 8½	857 19 8	558 17 10½
66 3 7	78 8 11½	785 13 11	477 8 8½
73 15 4	56 17 2¼	845 18 9	689 19 11¾

24	25	26	27
£371 9 5½	£657 13 6	£676 6 11½	£683 14 10
593 12 6¼	576 8 9	835 19 8¾	755 9 11
775 18 7¼	999 9 4	757 8 10½	649 7 4
862 5 8¾	628 11 8	888 17 3¾	587 18 8

28	29	30	31
£813 8 11¾	£753 9 10¼	£637 12 9¾	£937 12 11
539 18 3¼	389 8 11	728 19 11	468 19 10
642 3 8¾	648 11 4¾	888 13 6½	687 9 7
758 13 11½	537 12 7	473 9 8	345 7 9

32	33	34	35
£417 19 10½	£741 9 10¾	£337 11 10½	£937 18 10½
673 13 9¾	786 9 9½	857 19 11½	789 9 11¾
736 11 5½	637 18 11½	368 17 10¾	658 9 10¾
453 9 6¾	543 18 10½	875 16 11¾	876 11 9½
672 11 11¾	762 8 8¾	649 11 11¾	568 19 8¾

36	37	38	39
£49 2 8¼	£678 11 9¼	£673 12 7½	£84 11 7¼
97 17 10½	83 7 11½	287 19 11¾	68 17 9¾
354 18 11¾	546 14 7¾	671 5 9½	264 13 11¾
672 2 9¾	371 6 10¾	84 12 8¾	785 12 10½
695 12 7¼	18 17 6¼	170 1 7¼	859 9 6½

40		
£798	18	9½
3471	7	7¼
3878	6	6¾
95	15	8¾
77	17	3½
456	9	4¼

41		
£376	2	11¼
45	9	9¾
81	8	10½
295	4	8¾
857	5	11¾
69	6	11¼

42		
£73	12	11¾
98	19	9¾
256	18	2½
735	14	8½
84	15	7¼
69	16	5¾

43		
£329	13	11¼
7	9	2¾
654	17	6¾
85	2	8½
927	11	1¼
9	3	5¾

44		
£373	13	6½
491	15	9¼
678	12	2¾
856	18	11½
675	17	3¾
989	14	10¼

45		
£753	10	3½
869	17	7¾
378	9	11
837	12	10
456	7	8¾
638	15	4½

46		
£19	19	9¾
14	17	7¾
18	18	2¾
75	13	9¼
98	12	7½
77	11	6¾

47		
£419	2	10½
714	13	8¾
876	7	4¼
765	17	11¼
456	8	7¾
567	18	7½

48		
£97	10	6
379	5	11
479	19	11¾
685	13	7½
256	14	10¾
67	17	7½

49		
£371	18	11¾
757	17	1½
645	16	10¾
846	14	2¾
927	9	8¾
987	2	4½

50		
£735	15	11¾
647	17	10½
851	11	9¾
518	16	7¼
782	11	11
645	15	5¾

51		
£914	15	10¾
471	19	10
678	11	11¾
657	7	6
654	13	8½
765	5	8

52		
£731	17	2½
275	11	11
459	13	9¾
477	19	10
655	12	7½
319	17	7¾
276	13	8

53		
£7173	19	7¾
8657	12	10¾
8657	14	11¾
6527	18	11½
5678	12	2½
6573	18	10
7788	19	9¾

54		
£6719	12	9½
7238	13	7¾
8767	12	10
7597	15	6¼
6798	18	4¾
8479	19	9
7748	11	10½

55		
£7587	16	2¼
6789	16	9¼
5372	18	11¼
8495	12	11½
6578	12	4¾
8901	7	5½
9778	9	11¾

56		
£763	13	9¾
297	17	10½
471	12	11¾
755	11	2¾
654	19	9
765	13	11
837	17	10½
978	19	7¾
675	18	5½

57		
£989	11	11¼
541	9	2½
763	9	9¾
384	16	11½
597	11	11¾
756	15	9½
645	7	10¾
439	8	11½
798	3	4¾

58		
£768	18	10¼
679	17	9¾
785	9	2½
973	12	6¾
459	11	7½
768	17	10¾
475	19	9¾
981	5	11¼
815	19	11¾

59		
£967	12	8¾
679	11	6¼
876	18	9½
578	17	4¾
385	19	6
976	2	10
675	16	7¾
578	8	4½
899	13	11¾

60

lb.	oz.	dr.
3	7	13
27	14	7
14	0	9
6	12	15
15	14	10
7	13	8
12	6	11

61

qr.	lb.	oz.
3	27	13
1	10	8
2	16	15
0	18	8
3	13	11
1	19	9
0	7	6

62

tons	cwt.	qr.
17	18	3
23	13	1
16	15	0
0	17	1
38	0	3
12	9	2
56	2	3

63

oz.	dwt.	gr.
10	19	17
5	7	22
3	11	15
7	16	13
4	5	23
2	10	19
6	0	20

64

£437	12	7
374	19	2
581	18	8¾
815	15	5¾
675	2	3
789	14	6¼
894	7	10¼
777	13	7
386	8	9½
638	9	9
865	11	4½
568	3	1
372	4	6½
679	9	9
911	7	2¾

65

£779	12	11
264	13	10
645	9	7
837	7	6½
967	6	9¼
345	12	10¾
546	18	2½
672	11	3¾
837	9	7½
715	6	4
809	18	4
973	19	8¼
765	12	9¾
654	15	11½
436	7	1¾

66

£729	13	2¼
667	15	4½
726	19	7½
875	16	6¾
372	17	3¾
268	18	9½
848	13	10½
573	19	11¼
264	10	10½
431	11	2¾
352	14	7¾
617	17	3¼
708	16	8¼
490	1	5½
764	9	4½

67

£726	11	2
654	17	9½
472	13	10
981	19	11
183	12	6¾
719	6	4¼
215	18	9
654	4	10
954	17	2¾
677	12	3
836	8	8½
671	10	5
234	9	6½
345	10	9
517	11	7¾

68

£777	18	4½
765	10	7¾
876	17	9¼
643	12	6¾
987	8	7½
654	9	10¾
531	15	10½
798	19	9¼
898	18	11¾
674	11	10½
876	17	6¾
876	15	9¾
937	18	11½
476	19	9½
683	19	9½

69

£888	19	11¾
777	13	11¾
666	18	11¾
653	17	2¾
479	14	4½
797	16	10¼
641	17	6¾
937	19	5¾
876	19	4½
986	18	7¼
685	11	9½
568	11	6¼
639	9	10½
784	7	11½
479	6	11½

70

£979	17	11¾
899	11	10½
888	19	7¾
431	14	8¾
658	15	10½
727	18	10¾
473	17	9½
659	16	11¾
847	19	11½
798	14	6½
777	17	7¾
683	16	9¾
475	13	10½
578	15	7¾
967	11	9½

71

£987	19	0¾
365	17	10½
875	18	10¼
649	15	9½
768	16	7
867	16	10¾
978	17	11
853	17	11¾
987	19	9
649	14	6½
946	15	4
879	19	8½
979	17	11¼
987	15	11¼
879	12	10½

72		73			74					75			
Gal.	Qts.	Yds.	Qrs.	Nl.	Mls.	Fur.	Yds.	Ft.	In.	Acr.	Rd.	Pol.	Yds.
327	3	121	2	1	13	6	29	2	2	27	3	19	13
49	2	42	3	3	45	7	206	1	9	76	1	22	28
16	3	86	2	1	61	3	67	0	3	19	0	17	23
278	0	13	3	2	4	5	123	2	10	56	2	39	21
93	1	25	1	3	73	4	19	1	7	73	3	0	19

76.		77				78			79		
Gal	Pts.	Poles.	S. Yds.	S. Ft.	S. In.	C. Yds.	C. Ft.	C. In.	Bu.	Pks.	Gal.
723	5	13	22	8	74	27	17	864	73	3	1
876	7	4	19	7	28	13	13	333	798	2	0
27	3	5	28	6	79	34	10	92	564	1	1
18	6	2	14	1	11	43	19	248	349	3	1
33	2	26	16	5	83	36	25	17	523	0	0

COMPOUND SUBTRACTION.

1			2			3			4		
£75	18	9	£41	17	4	£67	12	11¾	£72	11	7½
39	10	1	39	10	2	50	4	0	14	5	0½

5			6			7			8		
£61	9	10¼	£17	10	0	£47	15	0	£66	16	3
43	2	10	12	7	5	44	11	3	49	7	10

9			10			11			12		
£80	18	4	£90	14	7	£15	15	0	£80	9	0
47	9	6	51	12	9	7	10	2½	7	4	7¾

13			14			15			16		
£41	17	4¼	£27	18	4½	£66	13	7¼	£12	17	8
16	16	7¾	18	17	7¾	57	6	10½	9	7	10

17			18			19			20		
£201	18	6	£74	13	7¼	£73	14	3½	£17	15	4½
171	7	9	18	11	9¾	37	9	9¾	9	10	7¾

21			22			23			24		
£709	3	5	£603	5	3	£806	4	7	£9	11	4¼
479	18	10	503	15	7	706	17	11	1	16	6¾

25			26			27			28		
£16	7	4	£83	9	7	£60	11	4¼	£54	9	7
9	13	8½	75	14	0¾	30	17	1¾	44	12	6½

29	30	31	32
£65 13 9	£71 10 4¼	£147 11 7¾	£164 7 1½
14 18 8¼	45 11 2	69 15 9¼	75 14 8
33	34	35	36
£216 14 11	£81 4 7	£615 15 7¼	£70 12 0¼
149 16 7¾	8 8 10½	279 16 10	40 19 4¾
37	38	39	40
£290 11 6¼	£78 5 5¼	£7 15 7	£861 12 7
178 19 9¾	59 19 10½	0 19 8	296 11 11¼
41	42	43	44
£79 11 11¼	£53 13 9½	£61 11 2¾	£300 13 4½
18 9 11½	38 18 7¾	29 15 7¼	71 15 6
45	46	47	48
£400 10 7½	£317 10 4¾	£607 8 11¾	£67 13 5½
99 11 0¾	217 5 5¼	376 9 1	48 7 10¾
49	50	51	52
£647 1 9½	£145 11 7¼	£60 0 7	£351 13 7½
297 13 6	90 10 9½	24 7 4¼	260 12 8¾
53	54	55	56
£49 11 7	£57 15 7½	£501 10 7¼	£71 1 10¼
32 11 10½	49 16 8	417 11 9½	37 3 9½
57	58	59	60
£99 3 7¼	£43 9 10	£87 6 2½	£70 13 7
79 6 9	17 9 11¼	78 11 3¾	49 18 11¾

	61			62			63			64			65	
Yds.	Ft.	In.	Pol.	Yds.	Ft.	Fur.	Po.	Yds.	Yds.	Qrs.	Nl.	S. Yds.	S. Ft.	S. In.
24	2	7	27	3	1	7	20	4½	27	3	2	29	5	57
13	1	8	13	3½	2	4	36	4	19	2	3	16	8	125

66	67	68
375 cwt. 3 qr. 18 lb.	2193 cwt. 1 qr. 13 lb.	7896 cwt. 2 qr. 24 lb.
140 — 2 — 9 —	178 — 2 — 20 —	3769 — 3 — 19 —

69
759 cwt. 1 qr. 21 lb.
372 — 1 — 25 —

70
2005 cwt. 1 qr. 22 lb.
1007 — 1 — 27 —

71
3040 cwt. 2 qr. 13 lb.
2050 — 3 — 19 —

72
73 qr. 11 lb. 9 oz.
39 — 23 — 6 —

73
813 qr. 12 lb. 13 oz.
219 — 17 — 14 —

74
60 qr. 24 lb. 10 oz.
29 — 11 — 12 —

COMPOUND MULTIPLICATION.

1. £12 2 0 × 5
2. 15 3 0 × 5
3. 34 5 0 × 6
4. 46 4 0 × 6
5. 73 7 0 × 7
6. 37 9 0 × 7
7. 18 13 0 × 5
8. 27 15 0 × 6

9. £29 17 0 × 4
10. 34 19 0 × 3
11. 38 11 0 × 5
12. 41 19 0 × 6
13. 71 11 4 × 3
14. 56 10 6 × 2
15. 84 12 8 × 2
16. 57 13 5 × 3

17. £75 14 7 × 4
18. 98 15 9 × 4
19. 345 5 9 × 7
20. 456 15 3 × 7
21. 564 6 8 × 8
22. 567 16 4 × 8
23. 576 7 11 × 9
24. 678 17 1 × 9

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25. £15 18 5¼ × 3
26. 365 13 7½ × 3
27. 473 16 9¾ × 3
28. 567 11 11½ × 4
29. 639 9 8¼ × 4
30. 741 8 2¾ × 4
31. 97 17 9¼ × 2
32. 65 15 11½ × 5

33. £87 18 10¾ × 2
34. 69 17 11¼ × 5
35. 96 14 11¾ × 2
36. 96 13 11½ × 5
37. 67 9 11¼ × 6
38. 76 11 3¼ × 6
39. 61 8 10¾ × 6
40. 57 15 6¾ × 7

41. £75 4 11½ × 7
42. 97 18 4½ × 7
43. 89 19 6¾ × 8
44. 98 18 7¾ × 8
45. 355 17 8½ × 8
46. 537 16 9½ × 9
47. 375 15 10¼ × 9
48. 648 14 11¼ × 9

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49. £47 10 10 × 10
50. 53 11 11 × 10
51. 65 17 9½ × 10
52. 358 18 8¾ × 10
53. 647 12 7¾ × 10
54. 752 16 11½ × 10
55. 68 17 3 × 12
56. 87 16 4 × 12

57. £78 19 5¼ × 12
58. 65 3 6½ × 12
59. 39 15 7¾ × 12
60. 47 8 8¾ × 12
61. 35 19 8½ × 11
62. 73 17 6¾ × 11
63. 86 11 11½ × 11
64. 59 19 2¼ × 11

65. £24 13 10¼ × 11
66. 18 15 7½ × 11
67. 37 19 6¾ × 11
68. 91 11 11¼ × 12
69. 64 18 7¾ × 11
70. 58 13 10½ × 12
71. 74 16 9¾ × 11
72. 62 15 11½ × 12

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73. £3 3 7 × 2 × 10
74. 5 4 9 × 2 × 12
75. 4 5 8 × 2 × 7
76. 6 6 10 × 2 × 11
77. 1 11 11 × 3 × 10
78. 7 17 8 × 3 × 12
79. 2 8 5 × 3 × 5
80. 8 9 9 × 3 × 6
81. 9 7 9 × 3 × 7
82. 10 6 11 × 9 × 3
83. 9 11 5¼ × 3 × 11
84. 7 11 6¼ × 4 × 10
85. 5 11 7¼ × 4 × 12
86. 3 7 10½ × 4 × 4
87. 4 9 9½ × 4 × 6
88. 6 9 11½ × 4 × 7
89. 8 7 11½ × 8 × 4
90. 10 8 10¼ × 4 × 11
91. 11 18 11¼ × 5 × 10
92. 9 15 4½ × 5 × 12
93. 9 6 5¼ × 5 × 5
94. 13 16 6¾ × 5 × 6
95. 13 5 7¼ × 5 × 7
96. 9 15 8½ × 5 × 8
97. 13 7 9¾ × 5 × 9
98. £71 10 11½ × 20
99. 89 0 10½ × 30
100. 42 10 9¾ × 40
101. 36 2 5¼ × 50
102. 81 12 6½ × 60
103. 72 3 7¾ × 15
104. 27 13 8¾ × 16
105. 34 4 9¾ × 18
106. 45 14 10½ × 24
107. 56 5 11¼ × 36
108. 23 15 2¼ × 48
109. 32 6 3½ × 60
110. 45 16 4¾ × 72
111. 54 7 5¾ × 14
112. 56 17 6¾ × 21
113. 65 8 7¼ × 22
114. 67 18 8½ × 27
115. 76 9 9¾ × 28
116. 78 19 9½ × 32
117. 87 10 11¼ × 33
118. 91 11 2¾ × 42
119. 95 12 3¼ × 44
120. 98 13 4½ × 45
121. 99 14 5¾ × 49
122. 99 15 6¾ × 54
123. £18 16 4½ × 55
124. 20 17 8¼ × 63
125. 19 18 8¾ × 64
126. 25 19 6¾ × 66
127. 21 16 7½ × 70
128. 29 17 7¼ × 80
129. 31 18 7½ × 90
130. 37 19 5¼ × 100
131. 48 18 5¾ × 110
132. 47 19 5¾ × 72
133. 45 11 10¾ × 77
134. 48 17 9¾ × 81
135. 49 2 8¾ × 84
136. 50 4 7½ × 96
137. 54 12 6¼ × 108
138. 58 14 5¾ × 120
139. 59 6 4¾ × 88
140. 60 5 3½ × 99
141. 67 16 2¼ × 110
142. 68 15 1¾ × 121
143. 69 7 9¾ × 121
144. 77 6 8½ × 132
145. 75 17 7¼ × 132
146. 78 16 6¾ × 121
147. 89 9 5¾ × 144

Let 10 be one of the factors, and add or subtract *one* as the case may require.

148. £7 18 0 × 31
149. 11 6 9¾ × 41
150. 19 2 10¾ × 51
151. 37 12 9¼ × 61
152. 8 12 0 × 29
153. £10 8 11½ × 39
154. 7 2 11 × 19
155. 57 19 7 × 59
156. 18 3 11¾ × 71
157. 59 14 11 × 69
158. £35 12 7 × 79
159. 29 13 7½ × 91
160. 549 2 6 × 89
161. 71 18 1¾ × 101
162. 43 17 5 × 111

Add or *subtract two* as the case may require.

163. £12 4 10¼ × 38
164. 40 4 8¾ × 52
165. 52 5 9¾ × 62
166. 55 13 8 × 58
167. £58 17 10 × 68
168. 67 11 8 × 82
169. 68 12 9 × 78
170. 74 10 11½ × 102
171. £945 7 6 × 98
172. 5 15 3 × 112
173. 12 11 7 × 118
174. 19 4 11 × 118

Let 12 be one of the factors, and add or subtract as the case may require.

175. £23 11 6 × 23
176. 34 13 8 × 37
177. 56 12 11 × 73
178. 67 17 3 × 85
179. 65 15 6 × 83
180. 954 9 5 × 97
181. £873 8 4 × 95
182. 431 10 8¼ × 107
183. 39 16 2 × 109
184. 10 15 6 × 34
185. 17 1 11¾ × 46
186. 53 16 4¾ × 74
187. £736 5 7 × 86
188. 837 7 3 × 94
189. 61 18 11 × 75
190. 673 7 8 × 87
191. 783 6 1 × 117
192. 87 6 11¾ × 106

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193. £47 17 9 × 117
194. 12 10 11¾ × 43
195. 41 14 6¼ × 53
196. £783 6 1 × 93
197. 78 12 2¼ × 103
198. 51 11 6 × 57
199. £56 15 9 × 67
200. 75 11 4¾ × 104
201. 63 16 10 × 76

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202. £7 18 6 × 100
203. 3 7 11 × 1000
204. 2 15 9 × 200
205. £9 16 10¼ × 2000
206. 6 19 7½ × 300
207. 5 17 7¾ × 3000
208. £6 16 8¼ × 400
209. 7 15 7¾ × 4000
210. 8 14 10¾ × 500

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211. £761 4 10¾ × 170
212. 757 18 11¾ × 108
213. 649 8 11¾ × 180
214. 34 18 9¾ × 232
215. 43 12 8¾ × 223
216. £54 16 7¾ × 334
217. 45 14 6½ × 343
218. 56 17 5¼ × 453
219. 65 15 4¼ × 435
220. 65 13 7½ × 556
221. £45 11 9½ × 565
222. 43 14 10¾ × 654
223. 52 13 6¾ × 564
224. 46 7 11¼ × 456
225. 47 9 10½ × 576

Multiply A. by the number of days from B. to C., including C.

	A.	B.	C.
226.	£68 15 6	× October 1st	to December 15th.
227.	16 18 11½	× December 15th	to March 1st.
228.	19 10 11¾	× March 1st	to July 31st.
229.	34 11 10	× July 31st	to September 30th.
230.	73 12 6	× September 30th	to December 31st.
231.	39 18 8	× November 16th	to March 2d.
232.	38 15 5	× November 21st	to June 11th.
233.	15 11 9½	× March 11th	to May 3d.
234.	17 12 10¾	× January 17th	to March 17th.
235.	23 15 8¼	× October 29th	to December 25th.
236.	34 14 6¾	× August 13th	to November 4th.
237.	54 16 7¾	× June 19th	to September 9th.
238.	78 11 5½	× June 10th	to December 9th.
239.	69 14 7¼	× June 10th	to November 18th.
240.	79 19 10¾	× July 14th	to January 15th.
241.	87 17 9	× July 14th	to February 1st.
242.	68 13 5¾	× May 7th	to September 29th.
243.	57 18 4½	× May 7th	to December 13th.
244.	61 19 11	× August 12th	to March 16th.
245.	90 11 9¾	× August 12th	to April 19th.

Multiply A. first by the days from B. to B. and then by the days from C. to C. and add their results together.

A. B. B. C. C.
246. £26 13 7 × July 27 to Oct. 30, then by May 25 to July 31.
247. 75 8 1 × Aug. 27 to Dec. 1, then by Jan. 11 to Mar. 28.
248. 39 11 5 × Mar. 7 to May 10, then by June 17 to Aug. 31.
249. 27 9 8 × Sep. 18 to Dec. 4, then by Feb. 15 to May 5.
250. 65 18 8¼ × Oct. 21 to Jan. 18, then by May 27 to Aug. 31.
251. 76 17 9½ × Dec. 24 to Mar. 23, then by Nov. 13 to Jan. 31.
252. 67 19 10¾ × April 15 to July 2, then by July 11 to Sept. 7.
253. 78 14 11¼ × Nov. 19 to Feb. 15, then by Feb. 15 to June 1.

COMPOUND DIVISION.

1. £38 ÷ 4
2. 29 ÷ 3
3. 47 ÷ 5
4. 23 ÷ 4
5. 31 ÷ 3
6. 64 ÷ 5
7. £12 2 ÷ 5
8. 15 8 ÷ 6
9. 34 5 ÷ 4
10. 46 4 ÷ 3
11. 73 7 ÷ 5
12. 37 9 ÷ 6
13. £18 13 ÷ 5
14. 27 15 ÷ 4
15. 29 17 ÷ 6
16. 34 19 ÷ 6
17. 38 11 ÷ 7
18. 41 19 ÷ 7
19. £71 11 4 ÷ 2
20. 56 10 6 ÷ 3
21. 84 12 8 ÷ 3
22. 57 13 5 ÷ 9
23. 75 14 7 ÷ 7
24. 98 15 9 ÷ 9

25. £15 18 5¼ ÷ 3
26. 536 13 7½ ÷ 3
27. 473 16 9¾ ÷ 3
28. 567 11 11½ ÷ 4
29. 639 9 8¼ ÷ 4
30. 741 8 2¾ ÷ 4
31. 97 17 9¾ ÷ 2
32. 65 15 11½ ÷ 5
33. £87 18 10¾ ÷ 2
34. 69 17 11¼ ÷ 5
35. 96 14 11¾ ÷ 2
36. 96 13 11½ ÷ 5
37. 67 9 11¼ ÷ 6
38. 76 11 3¼ ÷ 6
39. 61 8 10¾ ÷ 7
40. 57 15 6¾ ÷ 8
41. £75 4 11½ ÷ 8
42. 97 18 4½ ÷ 8
43. 89 19 6¾ ÷ 4
44. 8 17 11¾ ÷ 5
45. 5 10 10½ ÷ 7
46. 5 16 8¾ ÷ 6
47. 7 15 11¼ ÷ 8
48. 1 11 9¾ ÷ 3

49. £47 10 10½ ÷ 2
50. 2 9 11¼ ÷ 3
51. 65 17 9¼ ÷ 4
52. 348 15 8¾ ÷ 5
53. 3 19 7½ ÷ 6
54. 752 15 11½ ÷ 8
55. 68 17 3 ÷ 10
56. 87 16 4 ÷ 10
57. £5 19 10 ÷ 12
58. 11 14 5 ÷ 12
59. 96 14 11¾ ÷ 10
60. 98 13 11½ ÷ 12
61. 35 19 8½ ÷ 8
62. 73 17 6¾ ÷ 10
63. 86 11 11½ ÷ 12
64. 59 19 2¼ ÷ 8
65. £4 13 10½ ÷ 10
66. 18 15 7½ ÷ 12
67. 37 19 6¾ ÷ 7
68. 91 11 11¼ ÷ 9
69. 64 18 7¾ ÷ 11
70. 56 13 10½ ÷ 6
71. 7 19 11¾ ÷ 8
72. 62 15 11½ ÷ 12

73. £71 10 $11\frac{1}{4} \div 20$
74. 89 0 $10\frac{1}{2} \div 30$
75. 42 10 $9\frac{3}{4} \div 40$
76. 136 2 $5\frac{1}{4} \div 50$
77. 81 12 $6\frac{1}{2} \div 60$
78. 72 3 $7\frac{3}{4} \div 15$
79. 27 18 $8\frac{3}{4} \div 16$
80. 34 4 $9\frac{3}{4} \div 18$
81. 45 14 $10\frac{1}{2} \div 24$
82. 56 5 $11\frac{1}{4} \div 36$
83. 23 15 $2\frac{1}{4} \div 48$
84. 32 6 $3\frac{1}{2} \div 60$
85. 45 16 $4\frac{3}{4} \div 72$
86. 54 7 $5\frac{3}{4} \div 14$
87. 56 17 $6\frac{3}{4} \div 21$
88. 55 8 $7\frac{1}{4} \div 22$
89. 67 18 $8\frac{1}{2} \div 27$
90. 76 9 $9\frac{3}{4} \div 28$
91. 78 19 $10\frac{1}{2} \div 32$
92. 87 10 $11\frac{1}{4} \div 33$
93. 91 11 $2\frac{3}{4} \div 42$
94. 95 12 $3\frac{1}{4} \div 44$
95. 98 13 $4\frac{1}{2} \div 45$
96. 99 14 $5\frac{3}{4} \div 49$

97. £99 15 $6\frac{3}{4} \div 54$
98. 20 17 $8\frac{1}{4} \div 55$
99. 19 18 $8\frac{3}{4} \div 63$
100. 25 19 $6\frac{3}{4} \div 64$
101. 21 16 $7\frac{1}{2} \div 66$
102. 29 17 $7\frac{1}{4} \div 70$
103. 9 18 $5 \div 80$
104. 10 17 $9 \div 90$
105. 6 13 $11 \div 110$
106. 7 15 $4\frac{1}{2} \div 72$
107. 31 18 $7\frac{1}{2} \div 77$
108. 37 19 $5\frac{1}{4} \div 81$
109. 18 16 $4\frac{1}{2} \div 84$
110. 48 17 $9\frac{3}{4} \div 96$
111. 49 2 $8\frac{3}{4} \div 108$
112. 50 4 $7\frac{1}{2} \div 120$
113. 54 12 $6\frac{1}{4} \div 88$
114. 58 14 $5\frac{3}{4} \div 99$
115. 59 6 $4\frac{3}{4} \div 110$
116. 60 5 $3 \div 121$
117. 67 16 $2 \div 121$
118. 77 6 $8\frac{1}{2} \div 132$
119. 78 16 $6\frac{3}{4} \div 144$
120. 89 9 $5\frac{3}{4} \div 144$

Of £376 15s 8d find

121. The 3rd.
122. The 4th.
123. The 6th.
124. The 8th.
125. The 9th.
126. The 10th.
127. The 7th.
128. The 12th.

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129. $\frac{2}{5}$ of £72 10 6
130. $\frac{3}{5}$ of 47 17 9
131. $\frac{3}{8}$ of 56 15 8
132. $\frac{5}{8}$ of 65 5 $11\frac{1}{2}$
133. £88 18 $7 \times \frac{3}{10}$
134. 5 7 $11 \times \frac{7}{10}$
135. 3 19 $4 \times \frac{2}{7}$
136. 1 19 $11 \times \frac{5}{7}$
137. $\frac{2}{5}$ of £369
138. $\frac{3}{8}$ of 675
139. $\frac{7}{10}$ of 483
140. $\frac{5}{7}$ of 834

Fractions which, like the following, are less than one, by an aliquot or exact part of one, may be more easily found thus:—

Divide the sum of money by the aliquot part, and subtract the quotient from the dividend.

141. £9 5 $6 \times \frac{2}{3}$
142. 10 15 $4 \times \frac{3}{4}$
143. 7 6 $7 \times \frac{4}{5}$
144. 8 11 $0 \times \frac{5}{6}$
145. £9 10 $0 \times \frac{4}{5}$
146. 11 11 $0 \times \frac{3}{4}$
147. 59 1 $10 \times \frac{7}{8}$
148. 69 13 $6 \times \frac{9}{10}$
149. $\frac{11}{12}$ of £47 18 4
150. $\frac{5}{6}$ of 97 17 0
151. $\frac{8}{9}$ of 16 0 10
152. $\frac{10}{11}$ of 11 11 7

153. £3977 0 0 ÷31
154. 9658 0 0 ÷28
155. 6783 0 0 ÷29
156. 9817 0 0 ÷43
157. 645 12 0 ÷88
158. 654 13 0 ÷89
159. 721 14 0 ÷52
160. 483 15 0 ÷47
161. 75 9 6 ÷48
162. 64 10 5 ÷63
163. 37 11 9 ÷58
164. 48 13 10 ÷59
165. 67 8 10 ÷74
166. 49 10 7 ÷67
167. 51 17 11 ÷68
168. 28 18 3 ÷83
169. 93 1 11¼÷79
170. £95 11 10½÷ 95
171. 97 2 9¾÷ 55
172. 98 12 8¼÷ 65
173. 99 3 7½÷ 45
174. 67 13 6¾÷ 75
175. 45 4 5¾÷ 35
176. 83 14 4¾÷ 85
177. 754 13 0 ÷312
178. 865 15 0 ÷337
179. 976 17 0 ÷281
180. 687 19 0 ÷296
181. 398 18 0 ÷425
182. 799 16 0 ÷379
183. 897 14 0 ÷546
184. 688 12 0 ÷487
185. 564 11 0 ÷182

186. £37865 0 0÷ 647
187. 3756 0 0÷ 575
188. 43541 7 0÷ 738
189. 51672 17 6÷ 693
190. 76153 8 5÷ 829
191. 86374 18 8÷ 797
192. 78765 9 11÷ 945
193. 65445 19 3÷ 869
194. 79830 9 10÷ 879
195. 93875 19 2÷ 889
196. 468257 0 0÷3348
197. 913982 13 0÷2871
198. 176534 19 0÷4543
199. 918273 6 0÷3917
200. 645246 18 0÷5654
201. £813579 2 0÷4796
202. 648137 15 0÷6397
203. 375719 7 0÷5871
204. 753286 14 0÷7483
205. 468235 17 0÷6798
206. 301978 13 0÷6978
207. 665882 9 0÷8197
208. 396255 15 0÷7938
209. 375280 8 0÷7856
210. 801923 18 0÷7798
211. 751727 2 0÷9476
212. 710442 15 0÷8935
213. 816714 8 0÷8867
214. 882994 16 0÷8794
215. 467677 17 0÷8799

216. £7193 16 4÷ 2÷100
217. 5618 18 9÷ 4÷100
218. 6772 9 11÷ 8÷100
219. 8563 19 2÷10÷100
220. 3761 13 1÷ 3÷100
221. 7316 14 2÷ 6÷100
222. £6792 15 4 ÷ 9÷100
223. 5836 16 5 ÷12÷100
224. 794 16 7¾÷ 5÷100
225. 349 11 1 ÷ 8÷100
226. 298 13 7 ÷12÷100
227. 475 17 10 ÷ 8÷100

228. £9687 15 $2\frac{1}{2}$ ÷ 7300
229. 9798 19 $4\frac{1}{2}$ ÷ 7300
230. 65373 13 $3\frac{1}{2}$ ÷ 7300
231. 357928 11 8 ÷ 7300
232. 449873 12 6 ÷ 7300
233. 571785 8 $8\frac{1}{4}$ ÷ 73000
234. 672691 16 10 ÷ 73000
235. 700813 15 6 ÷ 73000
236. 9568721 17 8 ÷ 73000
237. 9774430 19 11 ÷ 73000
238. 19653782 10 9 ÷ 73000

239. £75319642 8 9 ÷ 73080
240. 96428376 15 6 ÷ ——
241. 82649135 7 4 ÷ ——
242. 95276341 18 4 ÷ ——
243. 43672598 1 4 ÷ ——
244. 37264815 19 3 ÷ ——
245. 47574311 8 5 ÷ ——
246. 92764853 8 1 ÷ ——
247. 46382269 0 5 ÷ ——
248. 91773364 15 9 ÷ ——
249. 54637281 19 2 ÷ ——

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250. 47 cwt. 3 qrs. 17 lbs. ÷ 5
251. 67 — 2 — 27 — ÷ 8
252. 92 — 1 — 23 — ÷ 11
253. 376 — 2 — 18 — ÷ 53
254. 671 — 3 — 21 — ÷ 49
255. 756 — 1 — 26 — ÷ 68
256. 79 mi. 7 fur. 202 yds ÷ 6
257. 348 — 3 — 119 — ÷ 57
258. 45 ac. 3 ro. 37 poles ÷ 43

259. 57 ac. 1 ro. 39 pols. ÷ 79
260. 715 deg. 39 m. 50 sec. ÷ 11
261. 472 — 40 — 49 — ÷ 85
262. 271 qrs. 5 bus. 1 pk. ÷ 47
263. 376 — 6 — 3 — ÷ 74
264. 763 cwt. 1 qr. 18 lbs. ÷ 239
265. 687 — 2 — 25 — ÷ 476
266. 872 — 3 — 22 — ÷ 638
267. 897 — 3 — 27 — ÷ 773

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268. 637198315 sh.* ÷ 5438
269. —————— ÷ 76834
270. —————— ÷ 88571
271. 57398256 pen. ÷ 769
272. —————— ÷ 58719
273. —————— ÷ 64729
274. —————— ÷ 79245
275. 729683078 far. ÷ 392
276. —————— ÷ 675
277. —————— ÷ 8319

278. 729683078 farth. ÷ 7826
279. —————— ÷ 6919
280. —————— ÷ 7345
281. —————— ÷ 9187
282. 73611982 lbs. av. ÷ 76
283. —————— ÷ 374
284. —————— ÷ 492
285. 607580097 lbs. av. ÷ 6573
286. —————— ÷ 7729
287. —————— ÷ 6677

MULTIPLICATION WITH A FRACTION.

1. £434 3 $4\frac{1}{4} \times \frac{7}{11}$
2. 543 13 $5\frac{1}{2} \times \frac{3}{8}$
3. 345 4 $6\frac{3}{4} \times \frac{2}{7}$
4. £56 14 $7\frac{1}{4} \times 9\frac{5}{8}$
5. 576 5 $8\frac{1}{2} \times 18\frac{5}{13}$
6. 687 15 $9\frac{3}{4} \times 17\frac{7}{13}$
7. £792 6 $10\frac{1}{4} \times 4\frac{7}{20}$
8. 789 16 $11\frac{1}{2} \times 5\frac{9}{30}$
9. 987 7 $11\frac{3}{4} \times 6\frac{1}{20}$

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10. £47 15 $9\frac{3}{4} \times 3\frac{1}{4}$
11. 65 17 $10\frac{1}{2} \times 4\frac{1}{3}$
12. 79 18 $11\frac{3}{4} \times 2\frac{1}{6}$
13. £74 18 $10\frac{3}{4} \times 7\frac{1}{13}$
14. 56 17 $11\frac{1}{4} \times 11\frac{1}{10}$
15. 97 15 $9\frac{1}{2} \times 9\frac{1}{8}$

*Reduce the result of this and the following accounts to their highest denomination.

16. £375 13 4$\frac{3}{4}$ × 12$\frac{1}{6}$
17. 497 17 11$\frac{1}{4}$ × 10$\frac{1}{12}$
18. 569 19 7$\frac{1}{2}$ × 9$\frac{1}{8}$

19. £375 13 4$\frac{1}{4}$ × 3$\frac{4}{5}$
20. 669 18 7$\frac{3}{4}$ × 4$\frac{3}{4}$
21. 477 9 10$\frac{1}{4}$ × 2$\frac{5}{8}$

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22. £759 17 11$\frac{1}{4}$ × 7$\frac{11}{12}$
23. 873 8 4$\frac{3}{4}$ × 11$\frac{9}{10}$
24. 897 19 11$\frac{1}{2}$ × 9$\frac{7}{8}$

25. £479 16 9$\frac{1}{2}$ × 23$\frac{5}{8}$
26. 587 17 9$\frac{3}{4}$ × 26$\frac{7}{8}$
27. 678 18 8$\frac{3}{4}$ × 28$\frac{11}{12}$

BILLS OF PARCELS.

FORM.

Edinburgh, 21st Sept., 1862.

JOHN THOMPSON, Esq.

Bought of FINLAY & Co.

	£	s	d
12 yards black silk, at 4s 6d a yard, . . .	£2	14	0
15 yards black satin, at 10s 6d a yard, . . .	7	17	6
25 yards linen, at 2s 1½d a yard, ...	2	13	1½
30 yards cotton cloth, at 9¾d a yard, . . .	1	4	4½
Amount, . . .	£14	9	0

Find the *amount* of the following Bills of Parcels.

1. 20 yards at	£2	5	9½	£
24	3	6	7	
30	4	7	8¼	
36	3	8	10	
				£

2. 40 yards at	£3	11	3¼	£
48	4	12	5	
50	4	11	7	
60	5	13	9¼	
				£

3. 70 yards at	£6	9	7	£
72	5	8	8½	
80	2	11	9¼	
84	1	11	10	
				£

4. 90 yards at	£5	3	6½	£
96	7	13	5¼	
100	4	2	4¾	
108	6	12	8½	
				£

5.	18 yards at	£9	4	6¾	£
	81	8	14	9½	
	21	3	5	8¾	
	72	7	15	11¼	
					£

6.	33 yards at	£6	16	7½	£
	44	8	14	7¼	
	55	10	13	7¾	
	66	12	12	7¾	
					£

7.	28 yards at	£0	18	7½	£
	32	0	19	11¼	
	42	0	16	9¾	
	45	0	17	8½	
					£

8.	54 yards at	£0	17	2¼	£
	63	0	18	3½	
	49	0	19	5¾	
	64	0	19	7¾	
					£

9.	72 yards at	£2	11	11½	£
	81	7	17	10¾	
	88	4	18	9½	
	99	11	12	9¾	
					£

10.	13 yards at	£3	12	7½	£
	17	13	13	8¾	
	19	7	14	6½	
	31	25	15	9¼	
					£

11.	29 yards at	£7	18	10¼	£
	26	9	14	11¾	
	34	11	15	9½	
	37	12	16	3¾	
					£

12.	41 yds. at	£11	11	11¼	£
	26	17	17	10½	
	38	29	18	9¾	
	43	73	15	7¾	
					£

13.	61 yards at	£9	14	11¼	£
	71	7	5	7½	
	91	8	19	10¾	
	52	11	7	9½	
					£

14.	62 yards at	£9	13	7¾	£
	59	11	15	8½	
	58	9	18	11¼	
	65	12	9	8½	
					£

15.	100 yds. at	£9	16	10¾	£
	100	8	13	9¾	
	99	23	17	10¾	
	98	47	19	7¾	
					£

16.	75 yds. at	£35	15	7½	£
	85	54	12	11¼	
	94	61	17	2¾	
	95	46	16	9½	
					£

17.	57 yds. at	£49	13	8½	£
	67	57	15	7¾	
	89	67	16	9¾	
	97	79	18	11¾	
					£

18.	76 yds. at	£18	15	9½	£
	86	19	17	8¼	
	87	29	19	10¾	
	97	73	18	11¼	
					£

			£	s	d	
19.	31	yards at	£1	3	6	£
	52	……	3	11	7	
	29	……	5	2	9	
	51	……	6	11	7	
						£

			£	s	d	
20.	39	tons at	£13	14	1	£
	58	……	3	17	11	
	62	……	4	11	9	
	42	……	16	17	10	
						£

			£	s	d	
21.	82	yards at	£0	15	4½	£
	47	……	0	16	11	
	85	……	0	17	9¾	
	102	……	0	18	8½	
						£

			£	s	d	
22.	95	yards at	£3	17	1	£
	73	……	4	9	9½	
	86	……	5	11	8	
	94	……	6	13	6¾	
						£

			£	s	d	
23.	91	yards at	£0	17	10¾	£
	93	……	1	11	9	
	37	……	6	7	11½	
	94	……	3	18	8¼	
						£

			£	s	d	
24.	43	tons at	£6	18	9¾	£
	103	……	11	15	11½	
	57	……	2	6	2¼	
	67	……	7	17	7¾	
						£

			£	s	d	
25.	100	yds. at	£1	13	9½	£
	200	……	2	17	11	
	150	……	3	6	9	
	270	……	1	11	8¾	
						£

			£	s	d	
26.	107	tons at	£5	17	9½	
	180	……	6	11	10¾	
	334	……	9	19	1	
	343	……	11	11	9	
						£

COMPOUND ADDITION AND SUBTRACTION.

1. Paid my grocer for tea £1 15s, for coffee 17s 9d, for sugar 6s 10½d, and for a ham, 13s 4d. How much did I pay him in all?

2. The latitude of the Cape of Good Hope is 33° 55′ 15″ south, and that of Gibraltar, 36° 6′ 30″ north; what is their difference of latitude?

3. A merchant on Monday bought goods to the amount of £576 15s 6d, on Wednesday to the amount of £47 7s 6d, on Friday, £79 19s 1½d, and on Saturday, £111 17s 7¾d; what is the amount of the four days' purchases?

4. I bought a book for 14s 3d and gave £1 to pay for it; how much should be returned to me?

5. A person's weekly income is £3 15s 6d, and he spends, on an average, £2 0s 8½d; how much does he save weekly?

6. A merchant bought goods at £50 16s 6d, and sold them for £63 1s 9½d; how much did he gain by the sale?

7. A merchant bought wheat for £7090 15s 6½d, which, having received damage, he sold for £6009 18s 11¾d; what was his loss?

8. The amount of a merchant's losses was £701 15s 9½d, and that of his gains £2015 7s 9d; what was his nett gain?

9. What sum added to £89 15s 11¾d will make it £200?

10. Paid £2060 15s for a furnished house, the furniture of which was valued at £690 18s 6d; how much was the house worth?

11. The weight of a crown is 18 dwt. $4\frac{4}{11}$ grains, and that of a shilling 3 dwt. $15\frac{3}{11}$ grains; how much is the crown heavier than the shilling?

12. From the sum of £213 17s 6d and £97 11s 9d, subtract the sum of £293 1s 9¾d + 17s 11½d, and £3 15s 11½d.

13. From the sum of £79 18s 4¾d + £629 13s 11d + £75 16s 11d, subtract the sum of £41 17s 11d + £315 18s 9d + £75 19s 11d.

14. The longitude of Madras is 80° 16′ east, and that of Cape Town 18° 28′ east; what is their difference of longitude?

15. Paid out of £8000 15s 6d the following sums, viz.: £230 10s 6d, £179 19s 4½d, £304 17s 8¾d, and £96 19s 2¾d; how much is left over?

16. Borrowed, at three different times, £71 15s, £98 10s 6d, and £530 11s 6d, and have paid back £17 17s, £90 10s, £15 17s 9d, and £368 19s; how much is still due?

17. From 1000 tons subtract the sum of 25 tons 12 cwt. 3 qrs. 21 lbs., 43 tons 11 cwt. 3 qrs. 20 lbs., 91 tons 1 cwt. 1 qr. 27 lbs., 10 tons 10 cwt. 24 lbs., 7 tons 17 cwt. 3 qrs., 98 tons 16 cwt. 3 qrs. 25 lbs.

18. A gentleman purchased three estates. The first consisted of 309 acres 3 roods 39 poles 20 yards, the second of 436 acres 1 rood 19 poles 30 yards, and the third was equal to a square mile. From the second estate he sold 159 acres 36 poles 15½ yards; what is the extent of his property?

19. A merchant has £4006 17s 9½d in goods, £250 10s 6¾d in cash, £49 16s 4d in debts due to him, and £496 18s 10d in bills receivable. He owes to A. £50 10s 6d, and to C. £14 15s 6d, and his bills payable amount to £790 18s 8d; what is his nett estate?

1. Find the price of 18 lbs. Bengal indigo, at £0 7 11½ per lb.
2. .... 25 lbs. Madras indigo, at 0 5 8¾ —
3. .... 35 lbs. cochineal, at 0 6 6¼ —
4. ....100 lbs. safflower, at 0 2 6¾ —
5. ....100 lbs. annato, at 0 2 3½ —
6. .... 50 lbs. cudbear, at 0 1 4½ —
7. .... 70 cwt. archill, at 4 4 8¼ per cwt.
8. ....200 cwt. turmeric, at 5 2 8½ —
9. ....105 cwt. fustic, at 1 2 8½ —
10. ....160 cwt. logwood, at 0 16 1½ —
11. How much will 3s 6¾d a day amount to in 35 days?

12. How much will a man's wages amount to in 48 days, at 4s 8¼d a day?

13. How much will 15s 6¾d a day amount to during the month of January?

14. If £12 8s 9¼d be the wages of certain workmen for a day. what will their wages amount to in the month of December?

15. What would a man's wages amount to from the 1st of March to the 15th of May (including both days), at 4s 9¼d a day?

16. What would the wages of 10 men amount to from August 21st to the end of November (including the last day), at £2 7s 6¾d a day?

17. What would the wages ot 15 men amount to from 7th February (leap year), to 24th June, both days included, at 3s 7½d a day each?

18. If a tradesman receives 3s 2½d a day for the first three months of the year, 3s. 8½d for the next three months, and 4s 1½d for the remainder of the year, how much is his annual income?

19. If a railway contractor pays his men £70 15s 6½d a day, how much will he pay them from 1st March to the end of June, including both days?

20. Calculate the duty on 99 cwt. Russian tallow, at 3s 2¾d per cwt.

21. .... 64 bushels malt, at 2s 7d per bushel.

22. .... 72 galls. whisky (used in Scotland) at 3s 8¾d per gallon.

23. .... 81 galls. whisky (sent to England), at 7s 10¾d per gallon.

24. .... 45 cwt. soap, at 14s 2¼d per cwt.

25. Calculate the duty on 99 cwt. hops, at 18s 8½d per cwt.
26. What is the value of ¾ of a ton of Riga hemp, £36 17 11 pr ton.
27. .... $\frac{2}{7}$ of a ton of Holland flax, 75 10 0 ——
28. ....10¾ oz. of gold,................ 3 17 10 per oz.
29. ....18⅔ oz. of platinum, ... 1 19 6¼ ——
30. ....35⅚ lbs. of silver,............. 3 0 3½ per lb.
31. .. ..45$\frac{4}{7}$ lbs. of nickel, ... 0 10 6¾ ——
32. ....60⅜ cwt. of tin, ... 4 2 6½ p.cwt.
33. ....100⅝ bottles of mercury,...... 4 8 8½ pr bot.
34. .. ..63$\frac{2}{9}$ tons of iron, ... 7 10 6¼ pr ton.
35. ... .63$\frac{2}{9}$ tons of iron, ... 8 15 11¾ ——
36. Find the value of 73⅜ tons of copper,..........92 6 8½ ——
37. ....73⅜ tons of copper,..........90 17 11¼ ——
38. ....107$\frac{7}{12}$ tons of zinc,............23 6 8¾ ——
39. ....107$\frac{7}{12}$ tons of zinc,............25 15 6½ ——
40. ....109$\frac{17}{20}$ tons of lead,........... 0 18 4¾ ——
41. ....109$\frac{17}{20}$ tons of lead,........... 0 17 11¾ ——

COMPOUND DIVISION.

1. Divide £500 by 34.

2. Divide £163 10s 6d among 100 persons equally.

3. If £156 13s 4d be divided equally among 20 men, how much will each receive?

4. What is the 54th part of £965 15s 8d?

5. What is the 12th part of £15 18s 8d?

6. A pound of gold is worth £46 14s 6d; what is the value of an ounce?

7. If a bottle, or 15 lbs. of mercury, cost £4 8s 8d how much is that per lb.?

8. What is the price of a pound of arrow root, if half a hundredweight cost £7?

9. A hundredweight of butter costs 98s, how much is that per pound?

10. An estate of 7003 acres 3 roods 25 poles was divided into ten farms of equal extent, what was the size of each?

11. An individual is in debt to the amount of £127 12s 4d; how much must he pay weekly to discharge the same in a year?

12. £2750 was gained on a business in which there are seven partners equally concerned; what is each partner's share of the same?

13. Divide equally among 225 persons the sum of £250 17s 9d + £765 13s 11½d + £848 10s 6d, and £3004 7s 6½d.

14. Bought 45 cwt. of sugar for £126, to which I add £7 17s 6d for profit, what must be the selling price of a cwt.?

15. Divide the difference of £7641 19s 11d, and £34 17s 11½d among 125 persons equally.

16. Find the fifth part of £95 15s 10d, which part multiply by 2 and by 3 separately.

17. Find the seventh part of £134 4s 6d, which multiply by 4 and by 3 separately.

18. Find the ninth part of £365 0s 6d, which multiply by 4 and by 3 and by 2 separately.

19. A. and B. enter into business, of the stock of which A. pays for three shares, and B. for two. In a month they gain £123 10s 6¼d; how much of this is due to each?

20. B. and C. enter into partnership; their capital is divided into seven shares, whereof B. advances 4, and C. 3; find, according to this proportion, B. and C.'s share of the first half-year's gain, which amounted to £340 16s 3d.

21. C. D. and E. join in an adventure by which they lose £786 13s 6d; how much of this will each require to pay, according to the following proportion, viz. C. 2 shares, D. 3, and E. 4?

22. A company's capital is divided into 2560 shares; their nett gain the first half-year was £4978 10s. 11d, and the next half year it amounted to £3554 15s 9d; what was the yearly dividend to A. who held 20 shares, to B. on 15 shares, and to C. on 17 shares?

EXERCISES

Intended chiefly to give facility in combining the processes of Addition, Subtraction, Multiplication, Division, and Reduction of compound quantities.

1. 15s 4½d + 17s 9¾d + 14s 11¼d × 3 × 4.
2. 17s 9¾d + £11 11s + £74 10s 6½d × 16.
3. £4 1s 6d + £2 17s 6d + £25 19s × 48.

4. £9 17s 6d+£340 10s—£17 0s 11½d×36.
5. £23 9s 6½d×45—£27 1s 11½d+£19 19s.
6. £46 1s 10d+£33 13s+£7 1s 7d—19s 11d×5÷2.
7. £86 3s 7d+£24 1s 9d+10s—(11s 7d+13s 4d)÷7.
8. £160 5s+£345 11s 6d+£130—£277 11s÷79.
9. 29 cwt. 3 qrs. 17 lbs+241 cwt. 1 qr. 16 lbs.—31 cwt. 27 lbs. ÷15.
10. 2644 mi.+17 mi. 7 fur. 37 po. ×5—265 mi. 14 po.÷92.
11. 7201 mi. 3 ro. 10 po.—150 ac. 2 ro. 27 po.×30÷54.

Add together A, B, and C—Subtract D—Multiply by E—and Divide by F.

	A.			B.			C.			D.			E.	F.
12.	£73	10	1	£59	1	11	£36	16	4	£98	18	5	2	3
13.	82	11	4	34	10	7	79	5	10	100	17	0	2	3
14.	91	6	8	55	15	10	97	7	7	27	13	11	3	2
15.	156	10	7	167	11	9¾	56	9	9	193	10	6	4	5
16.	245	11	10	236	17	11	65	15	4	15	15	0	5	4
17.	334	10	9	31	12	6½	53	17	2	331	10	10	7	8
18.	97	15	10½	504	13	2	39	19	11	56	18	5	9	7
19.	7	13	4¾	660	9	10¼	28	2	8	536	19	7	6	9
20.	145	17	6½	732	18	1	15	4	3	293	1	0	15	31
21.	863	14	9¼	273	6	11	9	6	6	385	10	10	18	37
22.	774	16	0	158	16	4	17	8	8	377	17	11	45	39
23.	685	12	2½	391	15	7¾	25	10	10	801	0	10	28	43
24.	279	18	0	176	17	3	61	12	7	76	17	0	35	345
25.	99	13	7¾	890	19	6¼	48	14	8¾	98	15	4	47	576
26.	293	14	0	908	16	2½	83	16	5¼	309	18	5	53	647
27.	846	15	6½	705	12	8¾	756	18	10¼	648	17	10	69	674
28.	679	16	10¾	654	14	9½	829	19	2¾	956	3	4	420	384
29.	876	17	0	436	8	4½	971	18	11½	468	8	9	507	592
30.	654	9	11½	547	10	5¼	176	17	4½	956	9	8	639	678
31.	349	1	11¾	721	6	7¾	863	16	1¼	793	19	8	456	856
32.	976	3	0½	839	17	6¼	456	14	0¾	657	18	7	109	433
33.	856	11	0¾	942	1	11¼	789	15	1¾	439	10	10	973	979
34.	473	9	7½	765	13	5¾	961	12	8½	799	18	1	873	655
35.	779	11	11	379	15	4½	797	17	8	979	11	7	25	31
36.	678	11	7¼	973	8	7¾	758	1	1¼	1276	15	3	50	45
37.	2	3	7½	351	7	11¾	256	18	1½	79	12	9	88	44
38.	19	13	8¾	476	13	9½	234	15	9¼	69	7	6	78	36
39.	57	7	8½	981	17	7¼	345	17	7¾	967	18	4	89	64
40.	94	19	10	189	19	5½	567	16	10½	76	17	11	95	75
41.	67	17	7¾	194	18	6¾	456	13	11¾	49	13	9	62½	93
42.	88	14	11½	887	16	3½	678	12	11¼	949	14	5	70¾	645
43.	69	15	5¼	749	14	8½	789	17	7¼	994	16	10	80¼	568
44.	64	14	9	974	12	1½	897	12	10	894	17	11	72¼	765

Substitute Reduction for Compound Multiplication and Division—

First Part.

45.	£17 10 0	× 37	53.	421 gal. 3 qts. 2 pts.	÷14
46.	56 1 6	× 43	54.	375 deg. 58 min. 19 sec.	÷56
47.	81 16 4	× 65	55.	289 lbs. 11 oz. 15 dwt.	÷67
48.	78 19 1¼	× 78	56.	209 cwt. 3 qrs. 11 lbs.	÷78
49.	49 13 11¾	× 97	57.	76 tons 19 cwt. 13 lbs.	÷89
50.	45 yds. 1 qr. 2 nails	×389	58.	789 qrs. 7 bush.	÷34
51.	70 mi. 7 fur. 115 yds.	×597	59.	567 cwt. 3 qrs. 1 lb.	÷48
52.	14 ac. 1 ro. 21 po.	×689	60.	987 cwt. 1 qr. 27 lbs.	÷99

Second Part (by Reduction).

61.	£25	17	6	×33	÷4		66.	£256	18	6½	× 21	÷ 57
62.	2749	18	11	×64	÷5		67.	9424	12	2¼	× 65	÷ 84
63.	5832	15	9	×75	÷6		68.	15136	11	3	×210	÷345
64.	8765	12	10	×96	÷7		69.	2695	19	9¼	×456	÷176
65.	4846	19	7	×87	÷8		70.	3787	17	10¾	×953	÷218

(1), Reduce A. and B. to the same denomination.
(2), Multiply C. by B.*
(3), Divide their product by A.
(4), Reduce the quotient to its highest name.

	A.	B.	C.
71.	7 yards 1 quarter	13 yards	25 shillings
72.	13 yards 2 quarters	5 yards 1 quarter	79 —
73.	2 yards 1 quarter	3 yards 3 nails	88 —
74.	5 yards	2 English ells	290 pence
75.	5 French ells	6 English ells	553 —
76.	3 quarts 1 pint	4 gallons 2 quarts	116 —
77.	1 gallon	1 quart 1 gill	102 —
78.	3 quarters 7 bushels	10 qrs. 5 bush. 3 pks.	338 farthings
79.	1 day 15 minutes	2 days	916 —
80.	3 miles 3 furlongs	25 furlongs 15 poles	720 —
81.	15 acres 1 rood	25 acres 3 roods	300 —
82.	2 acres	1 acre 2 poles	760 —
83.	1 acre	3 roods 10 poles.	199 —
84.	1 pound 5 oz. 10 dwt.	15 ounces 1 dwt.	856 —
85.	2 pounds 3 dwt.	1 ounce 2 dwt. 21 gr.	320 —

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* When two numbers are to be multiplied together, the greater should *generally* be multiplied by the less. Therefore, although C is required to be multiplied by B, when B (reduced) is larger than C, the pupil will of course multiply B by C, observing, however, that the product is always of the same name as C.

	A.	B.	C.
86.	£15 11s	£25 10s	987 pounds
87.	£7	£8 0s. 6d	1000 —
88.	15s 9½d	£2 0s 0¾d	256 —
89.	8 yards 2 quarters	18 yards	120 shillgs.
90.	14 yards 3 quarters	10 yards 1 quarter	304 —
91.	3 yards 2 quarters	8 yards 3 nails	56 —
92.	26 yards	27 English ells	780 pence
93.	66 French ells	61 English ells	908 —
94.	5 quarts 1 pint	9 gallons 1 pint	345 lbs. avr.
95.	2 gallons	16 quarts 1 gill	678 —
96.	4 quarters 6 bushels	5 quarters 3 bushels	900 —
97.	4 days 16 minutes	3 days	800 —
98.	1 mile 3 furlongs	3 furlongs 10 poles	6389 farthgs.
99.	18 acres 3 roods	20 acres 3 roods	6503 —
100.	7 acres	5 acres 7 poles	9507 —
101.	5 acres 1 pole	8 roods 9 poles	8000 —
102.	3 pounds 16 dwt	20 ounces 17 dwt.	4050 —
103.	5 pounds 3 dwt.	6 ounces 23 grains	9167 —
104.	£19 7s	£30 10s	76835 oz. troy
105.	£70	£43 1s 11d	9168 —
106.	18s 11¾d	£7 0s 4½d	7900 grains
107.	22 yards 11 inches	17 yards 5 inches	721 shilgs.
108.	15 ounces 15 grains	1 pound 15 dwt.	840 pence
109.	17 pounds 6 ounces	15 pounds 10 ounces	3721 farthgs.
110.	£7 7s 7½d	£9 10s 6¾d	7803 nails
111.	1 yard	1 quarter 3 nails	256 shilgs.
112.	8 square feet	1 sq. yd. 139 sq. inch	9006 pence.
113.	2 bushels 2 gallons	3 quarters 1 gallon	7320 —
114.	5 acres 3 roods	25 roods 1 pole	6500 farthgs.

FOURTH SECTION.

To find how often one compound quantity is contained in another of the same kind.

1. How often is 9s 6d contained in £9 10s ?
2. .... 13s 4½d contained in £16 14s 4½d?
3. .... 25s 6¾d contained in £38 6s 10½d ?
4. .... £2 17s 10d contained in £133 0s 4d?
5. .... 4 lbs. 5 oz. avoir. contained in 12 lbs. 15 oz. ?
6. .... 1 lb. 3 oz. 14 dwt. contained in 19 lbs. 7 oz. 10 dwt. ?
7. .... 3 yards 1 qr. contained in 22 yards 3 qrs. ?

8. How often is 3° 15′ 10″ contained in the circle, or 360°?

9. ……………… 1 lb. 14 oz. contained in 74 stones 11 lbs. 8 oz.?

10. ……………… 3 cwt. 22 lbs. contained in 191 cwt. 3 qrs. 4 lbs.?

The application of the above.

11. How long will a person be in saving £150 3s at the rate of 5s 6d per week?

12. How long can a person board for £15 4s 6d at the rate of 14s 6d a week?

13. How many pounds of cochineal, at 6s 6d a lb. may be bought for £19 3s 6d?

14. How many subscriptions, at 7s 6d each, would amount to £405?

15. The captain of a steam-boat collected £29 1s 6d in passengers' fares, at 15s 6d each, how many passengers were there?

16 A chest of tea is worth £18, at 4s 6d a lb., how many lbs. does it contain?

17. If £1 be the duty on 5 gallons 3 quarts of whisky, what will be the duty on 437 gallons?

18. A boy spent £32 during his holidays, at the average rate of 10s 8d a day, what was the length of his holidays?

19. How many sets of curtains, each requiring 18¾ yards, may be made from a piece of damask, measuring 113 yards 1 qr.?

20. A silversmith received 454 oz. 10 dwt. of silver plate, to be made into spoons, each weighing 12 dwt. 15 gr., how many will this quantity of silver make?

21. A garrison consumes daily 21 stones 6 lbs. of beef, how many soldiers will this supply, at 12 oz. a day each?

22. From 55 cwt. 3 qrs. 11 lbs. of iron, how many grates may be cast, each weighing 1 cwt. 27 lbs.?

23. How often, between Edinburgh and Glasgow, a distance of 46 miles, does a carriage wheel turn round, which is 10 feet 10 inches in circumference?

24. Into how many sections, of 2 roods 25 poles each, may 25 acres 3 roods be divided?

25. The average daily angular motion of Mercury is 4° 5′ 32″; in how many days will he perform one revolution?

26. A bankrupt paid his creditors £512 6s at the rate of 12s 6d a pound, what was the amount of his debts?

FIFTH SECTION.

To find how often one compound quantity is contained in another, multiplied by a given number.

1. How often is 3s 6d contained in 5s 6d, multiplied by 24?
2. .... 4s 9d contained in 3s 6d, multiplied by 48?
3. .... 17s 8½d contained in 25s, multiplied by 156?
4. .... 2 hours 40 minutes contained in a day, multiplied by 400?
5. .... 15 dwt. 23 gr. contained in 1 oz. 11 dwt. 22 gr multiplied by 57?
6. .... 2 cwt. 1 qr. 15 lbs. contained in 16 cwt. 3 qrs 21 lbs, multiplied by 429?

Application of the above.

7. In 235 Belgium florins, each worth 1s 6d, how many Vienna florins, of 2s each?

8. How many United States dollars, of 4s 6d each, are equal in value to 753 Prussian dollars, each worth 2s 10¾d?

9. In 7000 Russian silver roubles, each 3s 1½d, how many Spanish hard dollars, each worth 4s 2d?

10. How many piastres, of 3s 1½d each, are contained in 4000 milreis, each 4s 2d?

11. How many Bengal rupees, of 2s, are equal to 450 Bombay rupees, of 1s 10½d?

12. How many times could a vessel, which holds 3 gallons 2 quarts, be filled out of 25 barrels of ale, each containing 35 gallons 3 quarts?

13. A ship has on board, for its own use, 20 hhds. of wine, each, on an average, containing 63 gallons, how long will this quantity last, if the ship's daily allowance be 11 gallons 1 quart?

14. How many silver ornaments, each weighing 15 oz. 10 dwts. may be made out of 15 bars of silver, each weighing 46 oz. 10 dwt.?

15. How often is 2 cwt. 3 quarters contained in 24 bags of sugar, each weighing 3 cwt. 2 quarters?

16. How many chair covers, each requiring 3 quarters 2 nails, may be made from 10 pieces of print, each 22 yards 3 nails?

17. How much sugar, at 5½d per pound, should a farmer receive in exchange for 125 pounds of butter, at 7½d a pound?

18. How many yards, at 3s 6d, ought to be given in exchange for 25 yards, at 3s 9d ?

19. How many gallons of rum, at 12s 6d, should be given in barter for 150 gallons of a better quality, worth 15s 6d ?

20. How much brandy, at 30s a gallon, should be given for 1000 gallons of whisky, at 11s 6d a gallon ?

21. How much land, the rent of which is £1 5s an acre, should be exchanged for 540 acres, the rent of which is only £1 1s per acre ?

22. Required the length of a garden, 77 yards wide, which shall be equal to another 120 yards long and 88 yards wide.

23. By reckoning 97 leap years in every 400 years, we in that space of time (viz. 400 years) fall behind the sun 2 hours 40 minutes; how many years must elapse before it would be necessary to make the correction of a day for this error ?

When the divisior is the sum of several different quantities.

1. How many twopences and threepences, and of each an equal number, are in 12s 6d ?

2. How many fourpences and sixpences, and of each an equal number, are in £8 8s ?

3. How many half-crowns, shillings, and sixpences, and of each an equal number, are in £8 8s ?

4. How many half guineas, crowns, and half crowns, and of each an equal number, are in £22 10s ?

5. How many parcels, of 2 pounds, of 3 pounds, and 4 pounds, respectively, and of each an equal number, are contained in 2 cwt. 3 qrs. 25 lbs of sugar ?

6. How many parcels, of 2 pounds 5 ounces, 3 pounds 8 ounces, 7 pounds 10 ounces, and 34 pounds 13 ounces, and of each an equal number, may be made out of 9 cwt. 3 qrs. 17 lbs. 12 ounces ?

7. How many gold ornaments, of half an ounce, of 12 dwt. of 15 dwt. and of 18 dwt. respectively, and of each an equal number, may be made out of a piece of gold weighing 110 ounces ?

8. "If a coat requires 1 yard 3 quarters 1 nail of cloth, a vest 2 quarters 1 nail, and a pair of trousers 1 yard 2 quarters, how many suits of clothes may be made from a piece of cloth containing 104 yards 2 qrs 2 nails ?"

9. A. uses weekly in his establishment 15 gallons 3 quarts of ale, B. 10 gallons 1 quart, and C. 11 gallons 3 quarts, how many weeks would 29 barrels 13 gallons supply them all, the barrel containing 36 gallons ?

10. How many tea sets may be made out of 24 bars of silver, each weighing 24 ounces 6 dwt. the weight of each tea-pot being 27 ounces 15¾ dwt., of each sugar-basin 13 ounces 10¼ dwt., and of each cream-jug 7 ounces 6 dwt.?

11. A gentleman gave £250 to provide three industrial schools with beef, *each for the same length of time;* required how long this donation would supply them, if the first used weekly 10 stones 3 pounds, the second 15 stones 5 pounds, and the third 20 stones 13 pounds, the beef being purchased at 3½d per pound.

12. Four contractors, A. B. C. and D. are engaged to make a road 10 miles long. The men employed by A. make 30 yards 2 feet in a week, B.'s men make 59 yards 1 foot, C.'s 68 yards, and D.'s 62 yards; now, if all the men begin and continue *to work together*, in how many weeks will the road be finished, and how much of the road would each of the contractors have made?

13. A cistern, holding 828 gallons, has three cranes, A. B. and C. A discharges 20 gallons a minute, B. 34, and C. 15; in what time would it be emptied were the three cranes opened at one time, and how much would have been discharged by each?

A Revision of the Preceding.

1. Change £8576 19s 4½d to farthings.

2. Change 961 tons 13 cwt. 24 lbs. 15 oz. 11 drams to drams.

3. Change 965781396785006 drams to cwt.

4. Change 6780037005796500 farthings to pounds.

5. Change 965890 geographical miles into British miles.

6. Change 3 cwt. 3 quarters 15 oz. and 25 lbs. 13 drams to the same denomination.

7. Multiply £45 18s 6¾d at once by 3479. (Compound Reduction.)

8. From the sum of £68 13s 9½d, £453 17s 9¾d, and £579 13s 8½d, subtract £650 19s 11¾d, multiply the remainder by 45, and divide the product by 73000.

9. Reduce £43 17s 6½d to farthings, and multiply them by 456, and reduce the product to pounds.

10. Reduce 57 cwt. 3 quarters 1 pound to pounds, which multiply by 68, divide the product by 759, and reduce the quotient to cwt.

11. How often is 25 yards 3 quarters contained in 736 yards 3 nails?

12. How many tea-pots, each weighing 24 oz. 11 dwt. 15 grains, may be made out of 736 oz. 15 dwt. of silver?

13. How often is 7s 6d contained in £15 15s 6d?

14. How many yards of cloth, 5 quarters 1 nail wide, would cover the same surface as 240 yards, which are only 3 quarters 3 nails wide?

15. £25 15s 6d was divided among an *equal number* of men, women, and children, so that, as nearly as possible, each man received 10s 6d, each woman 7s 6d, and each boy 3s 6d; how many were there of each?

16. If for the sides of a box 8 feet 5 inches are necessary, and for the front and back 12 feet 10 inches, and for the top and bottom say 18 feet 8 inches, how many such boxes may be made from 254 feet 10 inches of wood?

17. Change 95 acres 3 roods 10 poles $15\frac{1}{4}$ square yards to square feet.

18. Take $\frac{5}{7}$ of £14 7s 7d, to which add £13 4s $0\frac{3}{4}$d, and multiply the sum by 48.

19. Add $\frac{1}{3}$ of £16 19s $6\frac{1}{2}$d, $\frac{3}{4}$ of £21 18s $5\frac{1}{4}$d, and $\frac{11}{12}$ of £31 17s 11d, neglecting fractions of farthings, subtract 11s $11\frac{3}{4}$d from the sum, and divide the difference by 100.

20. Take $\frac{3}{8}$ of the difference of £13 14s 7d, and £2 15s 8d, and add to it $\frac{4}{9}$ of the difference of £360 15s 9d, and £29 17s 11d, and divide the sum by 20.

21. Add together the following products, and divide their sum by the sum of the multipliers, £45 10s 6d × 7, £54 17s 3d × 15, £36 14s 11d × 18, and £765 10s 6d × $54\frac{3}{4}$.

22. Divide the sums of the following quotients (rejecting fractions of farthings) by $25\frac{7}{9}$, viz. £7360 17s ÷ 100, £396500 15s ÷ 7300, and £367598420 10s ÷ 73000.

23. Multiply $\frac{11}{12}$ of £36 18s by $35\frac{2}{3}$, multiply $\frac{7}{8}$ of £90 17s 10d by $50\frac{3}{8}$, multiply $\frac{5}{6}$ of £18 18s 6d by $72\frac{1}{9}$, and add these products together.

24. Multiply the quotient of £41 18s 6d ÷ $2\frac{3}{4}$ by 7, multiply the quotient of £345 18s 8d ÷ $35\frac{4}{5}$ by 8, add the products together, and subtract from their sum the difference of £365 14s 9d and £850 19s $11\frac{1}{4}$d, multiplied by $1\frac{1}{3}$.

Where fractions of farthings occur in the last sums, reject them.

INTRODUCTION TO PRACTICE.

The characteristic feature of the Practice methods of calculating is, that the value of the quantity is *first* found at a supposed price, which requires little or no calculation (such as a pound or a shilling), and the real value is found either by taking a part of this result, or by subtracting a part from it, and taking the remainder, or by some other process, which is easy and evident.

Thus, for example, it requires no calculation to discover that 313 yards at £1 would amount to £313. Now, if the value of 313 yards at 10s were required, we would at first suppose the price to be £1, the result of which, as just stated, we at once perceive to be £313; and as 10s, the real price, is the half of £1, we conclude that the real value of the 313 yards will be the half of £313, and accordingly divide the £313 by 2, by which the result is found to be £156 10s. The real value, then, of 313 yards at 10s, is £156 10s. If the price of 313 yards at 6s 8d were required, we would take the *third* of £313; at 5s, we would take the *fourth*, and so on.

On this principle, of supposing a price which requires little or no calculation, and from it obtaining the value at the real price, is founded all the Practice processes, of which the following are the most generally useful.

The calculations which should be made by the Practice methods are distinguished by the price.

RULES OF PRACTICE.

CASE I.

First Division.

The prices which are exact or aliquot parts of a pound.

Table of the aliquot parts of a pound.

S.	D.		
10	0 =	$\frac{1}{2}$	of a pound.
6	8 =	$\frac{1}{3}$	——
5	0 =	$\frac{1}{4}$	——
4	0 =	$\frac{1}{5}$	——
3	4 =	$\frac{1}{6}$	——
2	6 =	$\frac{1}{8}$	——
2	0 =	$\frac{1}{10}$	——
1	8 =	$\frac{1}{12}$	——
1	0 =	$\frac{1}{20}$	——

Second Division.

The prices which are less than a pound by an aliquot part of a pound.

Table of such prices.

S.	D.		S.	D.		
13	4	is less by	6	8	or $\frac{1}{3}$	of £1
15	0	——	5	0	or $\frac{1}{4}$	——
16	0	——	4	0	or $\frac{1}{5}$	——
16	8	——	3	4	or $\frac{1}{6}$	——
17	6	——	2	6	or $\frac{1}{8}$	——
18	0	——	2	0	or $\frac{1}{10}$	——
18	4	——	1	8	or $\frac{1}{12}$	——
19	0	——	1	0	or $\frac{1}{20}$	——

RULE 1.—(*First Division.*)

When the price is one of the above aliquot parts of a pound (1), suppose the quantity pounds (2), and take the same part of them as the price is of a pound for the answer.

Example.—Find the value of 217 yards at 3s 4d.

(1) Suppose the 217 yards to be £217, and as 3s 4d is the sixth of a pound (2), take the sixth part of £217 for the answer; thus—

6 | £217	The value of 217 yards at a pound.
£36 3 4	The sixth part of this value, or the value at 3s 4d.

217 yards at 3s 4d, amount to £36 3s 4d

Rule II.—(*Second Division.*)

When the price is less than a pound, by an aliquot part of a pound (1), suppose the quantity pounds (2), take the same part of them as the *difference* between the price and a pound is of a pound (3), and subtract this part from the quantity, as pounds, for the answer.

Example.—Find the value of 511 yards at 17s 6d.

17s 6d is less than a pound by 2s 6d, or one-eighth of a pound. (1) Suppose the 511 yards to be £511 (2), take the eighth part of £511 (3), and subtract the result from £511; thus—

8 | £511	The value at a pound.
£63 17 6	The one-eighth of this value, or the value at 2s 6d
£447 2 6	The difference, or the value at 17s 6d.

511 yards, at 17s 6d, amount to 447 2s 6d.

CASE II.

First Division.

The prices which are aliquot parts of a shilling.

Table of the aliquot parts of a shilling.

6d = ½ of a shilling.
4d = ⅓ ——
3d = ¼ ——
2d = ⅙ of a shilling
1½d = ⅛ ——
1d = $\frac{1}{12}$ ——

Second Division.

The prices which are less than a shilling by an aliquot part of a shilling.

Table of such prices.

8d is less than a shilling by 4d or ⅓.
9d —————————— by 3d or ¼.
10d —————————— by 2d or ⅙.
10½d —————————— by 1½d or ⅛.
11d —————————— by 1d or $\frac{1}{12}$.

Rule I.—(*First Division.*)

When the price is an aliquot part of a shilling, (1) suppose the quantity shillings (2), take the same part of them as the price is of a shilling (3), and reduce the result to pounds.

Example.—Find the value of 307 yards at 2d.

2d is the sixth part of a shilling. (1) Suppose the 307 yards to be 307 shillings, (2) take the sixth part of 307 shillings, (3) and reduce the result to pounds for the answer; thus—

6 | 307 shillings, the value of 307 yards at a shilling.
20 | 51 2d. The 6th part of the value, or the value of 307 yds. at 2d.
£2 11s 2d. The same reduced to pounds.
307 yards, at 2d, amount to £2 11s 2d.

Rule II.—(*Second Division.*)

When the price is less than a shilling, by an aliquot part of a shilling—1, suppose the quantity shillings; 2, find the same part of this number of shillings as the *difference* between the price and a shilling is of a shilling; 3, from them, as shillings, subtract this part; 4, and reduce the result to pounds.

Example.—Find the value of 413 yards at 9d.

Ninepence is less than a shilling by one-fourth of a shilling. Suppose the 413 yards to be 413 shillings, find the fourth part of 413 shillings, subtract this part from 413 shillings, and reduce the result to pounds; thus—

4 | 413 shillings, or the value of 413 yards at 1s.
103s 3d. The fourth part, or the value of 413 yds. at 3d.
20 | 309s 9d. The difference, or the value of 413 yards at 9d.
£15 9s 9d. The last result reduced to pounds.
The value of 413 yards, at 9d, amounts to £15 9s 9d.

CASE III.

First Division.	*Second Division.*
The prices which exceed a pound, or a number of pounds, by an aliquot part of a pound; such as £1 2s 6d, £5 3s 4d, or £7 10s, &c.	The prices which are less than the exact number of pounds next higher by an aliquot part of a pound; such as £2 15s, £3 16s £1 17s 6d, &c.

Rule I.—(*First Division.*)

When the price exceeds a pound, or a number of pounds, by an aliquot part of a pound, such as £1 2s 6d, or £3 10s, or £4 6s 8d, express it thus—£1 2s 6d call £1⅛; £3 10s consider £3½; £4 6s 8d, consider £4⅓; (1) then suppose the quantity pounds, (2) and multiply them by 1⅛, or 3½, or 4⅓, as the case may be.

Example.—431½ yards at £2 6s 8d.

£2 6s 8d equal to £2⅓. (1) Suppose the 431½ yards to be £431 10s, (2) and multiply them by 2⅓, thus:

£431 10s	The value of 431½ yards at a pound.			
2⅓				
£143 16s 8d	The third part of £431 10s, or the value of 431½ yards at	£0	6	8
863 0s 0d	The product by 2, or the value of 431½ yards at	2	0	0
£1006 16s 8d	Their sum, or the value of 431½ yards at	£2	6	8

Rule II.—(*Second Division.*)

When the price is less than the exact number of pounds next higher, by an aliquot part of a pound, (1) multiply the quantity supposed to be pounds by the number of pounds next higher than the given price, (2) find the same part of the quantity considered pounds as the difference between the price and the multiplier is of a pound, (3) and subtract the quotient from the product.

Example.—Find the value of 773 yards at £4 13s 4d.

£4 13s 4d is less than £5 by 6s 8d or ⅓ of a pound. (1) Multiply £773 by 5; (2) find the third part of £773, and subtract the quotient from the product, thus:

£773	Or the value of 773 yards at a pound.			
5—⅓				
3865	The product by 5, or the value of 773 yds. at	£5	0	0
257 13s 4d	The third part of £773, or the value of 773 yards at	0	6	8
£3607 6s 8d	Their difference, or the value of 773 yds. at	£4	13	4

The value of 773 yards at £4 13s 4d is £3607 6s 8d.

CASE IV.

First Division.

The prices which are more than an exact number of shillings by an aliquot part of a shilling, as 1s 6d, 2s 3d, 3s 4d, &c.

Second Division.

The prices which are less than the exact number of shillings next higher, by an aliquot part of a shilling, as 1s 8d, 2s 9d, 3s 10d, &c.

Rule I.

When the price exceeds an exact number of shillings by an aliquot part of a shilling, express it as follows: for 4s 4d write $4\frac{1}{3}$; for 3s 2d write $3\frac{1}{6}$, &c., (1) then multiply the quantity supposed to be shillings by the $4\frac{1}{3}$, or the $3\frac{1}{6}$, as the case may be, (2) and reduce the product to pounds.

Example.—Find the value of 117 yards at 4s $1\frac{1}{2}$d.

4s $1\frac{1}{2}$d=$4\frac{1}{8}$ shillings. (1) Suppose the 117 yards to be 117 shillings, (2) multiply the shillings by $4\frac{1}{8}$, (3) and reduce the result to pounds; thus:

117 shillings or the value of 117 yards at a shilling.
$4\frac{1}{8}$
14s $7\frac{1}{8}$d Quotient by 8, or the value of 117 yards at $1\frac{1}{2}$d.
468 Product by 4, or the value of 117 yards at 4s.
20 | 482s. $7\frac{1}{8}$d Their sum, or the value of 117 yards at 4s $1\frac{1}{2}$d.
£24 2s $7\frac{1}{8}$d The last result reduced to pounds.

Rule II.—(*Second Division.*)

When the price is less than the exact number of shillings next higher by an aliquot part of a shilling, (1) multiply the quantity as shillings by the exact number of shillings next higher than the given price; (2) find the same part of the quantity considered shillings as the difference between the real price and the multiplier is of a shilling; (3) subtract this part from the product, (4) and reduce the result to pounds.

Example.—Find the value of 1329 yards at 12s 11d.

(1) Multiply 1329 shillings by 13, the number of shillings next higher than the price; (2) find the twelfth part of 1329 shillings; (3) subtract this part from 1329 shillings, (4) and reduce the result to pounds; thus:

1329 shillings, the value of 1329 yards at a shilling.
13—$\frac{1}{12}$
3987
1329
17277 Product by 13, or the value of 1329 yds. at 13s 0d
110 9d Quotient by 12, or the value of 1329 yds. at 0s 1d
20 | 17166 3d The difference, or the value of 1329 yds. at 12s 11d
£858 6s 3d The last result reduced to pounds.

CASE V.

When the price exceeds an exact number of pounds by one of the prices of the preceding case, as £3 2s 9d, &c.

RULE.

(1) Calculate for the price of the preceding case by the rule given above, (2) then multiply the quantity as pounds by the number of pounds, (3) and add the two results together.

Example.—Find the value of 75 yards at £2 5s 9d.

£2 5s 9d is less than £2 6s by 3d, or one-fourth of a shilling= £2 6—¼s. (1) Multiply 75s by 6; (2) from the product subtract a fourth of 75s; (3) reduce the remainder to pounds; (4) multiply £75 by 2; (5) and add the two results together; thus:

	75			
	£2	6—¼		
	450			Product by 6, or the value of 75 yards at 6s.
	18	9		Quotient by 4, or the value of 75 yards at 3d.
20	431	3		Their difference, or the value of 75 yards at 5s 9d.
	£21	11	3	The last result reduced to pounds.
	150			The product of 2, or the value of 75 yards at £2.
	£171	11	3	Their sum, or the value of 75 yards at £2 5s 9d.

75 yards at £2 5s 9d amount to £171 11s 3d.

CASE VI.

When the quantity consists of several denominations, multiply the price by the quantity of which the rate is given, and take parts of the price for the lower denominations.

Example.—Find the value of 27 cwt. 3 qrs. 21 lbs. at 47s 6d per cwt.

2 qrs.=	½	£2	7	6
				3
		7	2	6
				9
		64	2	6
1 qr. =	½	1	3	9
14 lb.=	½	0	11	10½
7 lb.=	½		5	11¼
			2	11½
		£66	7	0¼

EXERCISES ON PRACTICE.

CASE I.

First Division.

When the price is an aliquot part of a pound, as 3s 4d.

1. 7409 at 10s.
2. 5067 — 5s.
3. 3459 — 2s 6d.
4. 7895 — 6s 8d.
5. 3759 at 3s 4d.
6. 9185 — 1s 8d.
7. 4684 — 4s.
8. 3008 — 2s.
9. 7[illegible]06 at 1s.
10 2973 — 1s 8d.
11. 8450 — 2s 6d.
12. 6700 — 1s 8d.

Second Division.

When the price is less than a pound by an aliquot part of a pound.

13. 371 at 15s.
14. 593 — 16s.*
15. 647 — 18s.
16. 758 — 16s 8d.
17. 837 — 13s 4d.
18. 379 — 17s 6d.
19. 982 — 18s 4d.
20. 817 at 19s.
21. 3785 — 15s.
22. 7835 — 16s 8d.
23. 8537 — 18s.
24. 3796 — 13s 4d.
25. 6975 — 16s.
26. 9765 — 17s 6d.
27. 7957 at 19s.
28. 7659 — 18s 4d.
29. 4763 — 17s 6d.
30. 9764 — 13s 4d.
31. 9876 — 16s.
32. 8765 — 18s.
33. 7654 — 18s 4d.

CASE II.

First Division.

When the price is an aliquot part of a shilling.

34. 3045 at 6d.
35. 1797 — 3d.
36. 4583 — 1½d.
37. 9801 — 4d.
38. 5179 — 2d.
39. 8265 at 1d.
40. 3457 — 6d.
41. 2030 — 4d.
42. 7111 — 3d.
43. 6207 — 1½d.
44. 4001 at 1d.
45. 721 — 1d.
46. 7103 — 1½d.
47. 935 — 4d.
48. 2713 — 1½d.

Second Division.

When the price is less than a shilling by an aliquot part of a shilling.

49. 4763 at 9d.
50. 9764 — 8d.
51. 746 — 10d.
52. 951 — 10½d.
53. 4976 — 11d.
54. 647 — 9d.
55. 9859 — 8d.
56. 5890 at 10½d.
57. 9085 — 10d.
58. 3456 — 11d.
59. 7436 — 11d.
60. 5657 — 11d.
61. 4353 — 10d.
62. 7644 — 10d.
63. 6735 at 10½d.
64. 972 — 10½d.
65. 855 — 8d.
66. 792 — 9d.
67. 5885 — 10d.
68. 2797 — 10½d.
69. 9867 — 11d.

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* When the price is an even number of shillings, (1) multiply the quantity by half the number of shillings; (2) double the right hand figure of the product for the shillings of the answer, and consider the other figures of it pounds.

CASE III.

First Division.

When the price exceeds a pound, or a number of pounds, by an aliquot part of a pound.

70.	35½	tons at	£3	10	0
71.	45¼	———	5	6	8
72.	67¾	———	7	5	0
73.	73⅛	———	4	4	0
74.	84 1/12	———	3	3	4
75.	89	———	7	2	0
76.	818	———	8	1	8
77.	653	———	3	2	6
78.	356	———	1	6	8
79.	563 1/10	tons at	£3	3	4
80.	781	———	10	2	6
81.	178 1/20	———	73	10	0
82.	871	———	25	6	8
83.	256⅖	———	54	1	8
84.	654¾	———	30	4	0
85.	374	———	2	2	6
86.	734	———	3	3	4
87.	437½	———	4	4	0

Second Division.

When the price is less than the exact number of pounds next higher, by an aliquot part of a pound.

88.	683	tons at	£3	13	4
89.	863	———	7	13	4
90.	638	———	9	13	4
91.	386	———	6	15	0
92.	4160	———	2	16	0
93.	2070	———	2	16	8
94.	3009	———	3	16	8
95.	2134	———	4	16	8
96.	3579	———	9	19	0
97.	9260	———	11	19	0
98.	6073	———	6	18	4
99.	5806	———	7	18	4
100.	3455	tons at	£8	16	0
101.	671	———	9	16	0
102.	789	———	5	17	6
103.	453	———	4	17	6
104.	543	———	4	18	0
105.	654	———	15	15	0
106.	765	———	17	17	6
107.	891	———	16	16	0
108.	918	———	18	18	0
109.	37	———	23	13	4
110.	49	———	54	16	8
111.	55	———	35	17	6

CASE IV.

First Division.

When the price exceeds a number of shillings by an aliquot part of a shilling.

112.	731	yards at	£0	3	6
113.	9306	———	0	4	6
114.	879	———	0	5	4
115.	6390	———	0	6	4
116.	789	———	0	7	3
117.	7683	———	0	8	3
118.	987	———	0	9	2
119.	3578	———	0	10	1½
120.	345	———	0	11	1
121.	6578	yards at	£0	13	6
122.	379	———	0	14	4
123.	9876	———	0	15	3
124.	54	———	0	16	2
125.	73	———	0	17	1
126.	384	———	0	18	1½
127.	7568	———	0	14	3
128.	5786	———	0	13	1½
129.	8756	———	0	11	4

SECOND DIVISION.

When the price is less than the exact number of shillings next higher by an aliquot part of a shilling.

130.	641	yards at	£0	5	8
131.	146	———	0	7	8
132.	345	———	0	6	9
133.	453	———	0	3	9
134	435	———	0	4	10
135.	679	———	0	5	10
136.	769	———	0	6	10½
137.	7631	———	0	7	10½
138.	4563	———	0	6	9
139.	8729	———	0	5	8

140.	3457	yards at	£0	4	10
141.	4735	———	0	3	10½
142.	6173	———	0	2	10½
143.	7541	———	0	1	10½
144.	47	———	0	11	8
145.	58	———	0	12	9
146.	69	———	0	13	10
147.	83	———	0	14	10½
148.	91	———	0	15	11
149.	78	———	0	16	10½

CASE V.

When the price exceeds a number of pounds by one of the prices of the Fourth Case.

150.	456	yards at	£2	3	6
151.	3465	———	3	4	6
152.	654	———	4	5	4
153.	5643	———	5	6	4
154.	567	———	5	7	3
155.	4576	———	4	9	2
156.	765	———	3	10	1½
157.	6754	———	6	11	1
158.	678	———	6	13	6
159.	5687	———	7	14	4
160.	876	———	7	15	3
161.	7685	———	6	16	1½
162.	789	———	6	18	1¼
163.	8467	———	2	5	8
164.	4937	———	2	7	8

165.	8967	yards at	£3	6	9
166.	9437	———	3	16	10
167.	768	———	3	3	9
168.	896	———	4	7	10½
169.	876	———	4	17	8
170.	374	———	4	7	11
171.	6478	———	5	11	11
172.	6987	———	5	13	9
173.	979	———	5	18	10½
174.	889	———	5	19	9
175.	998	———	5	10	10½
176.	23	———	10	7	10½
177.	34	———	12	16	2
178.	45	———	14	8	3
179.	56	———	15	19	8

CASE VI.

When the quantity consists of more than one denomination.

180.	12 cwt. 1 quarter 7 lbs.,	at	£2	17	9
181.	3 — 3 — 5 —	at	1	14	4
182.	227 — 3 — 14 —	at	3	8	6
183.	65 — 2 — 24 —	at	3	10	0
184.	81 tns. 16 cwt. 3 qrs. 8 lbs.	at	4	3	9
185.	23 acres 2 roods, 16 poles,	at	60	10	6
186.	42 quarters, 6 bushels,	at	2	10	3
187.	38 gallons, 3 pints,	at	0	18	6

COMMERCIAL ALLOWANCES ON GOODS.

The whole weight of any commodity, including the weight of the box, or whatever contains it, is called its gross weight, and the weight of that which contains the goods is called the tare.

Tret is an allowance for waste of $\frac{1}{26}$ or 4 lbs. on each 104 lbs. after the tare is deducted.

Draft is an allowance of so much per hhd., bag, &c., that the weight may hold out when sold by retail.

Net weight is what remains after all deductions are made.

When the tare is at so much for each package, subtract it from the gross weight for the net weight—when draft is allowed subtract it first.

When the tare is at so much per cent. or per cwt., take the same part of the quantity that the rate is of a 100 or of a cwt., as the case may be. When a fraction less than ½ lb. occurs in calculating for the tare, reject it, but if more than ½ lb. reckon it a whole pound.

EXERCISES.

1. What is the net weight of 11 cwt. 0 qr. 24 lb., tare 1 cwt. 1 qr. 25 lb.?
2. What is the net weight of 27 cwt. 3 qr. 17 lb., tare 2½ per cent.?
3. What is the net weight of 18 cwt. 1 qr. 14 lb., tare 56 lb., and tret as usual?
4. What is the net weight of 3 barrels of rice weighing as follows: —No. 1, 3 cwt. 3 qr. 17 lb., tare 56 lb.; No. 2, 4 cwt. 1 qr. 25 lb., tare 59 lb.; No. 3, 3 cwt. 2 qr. 27 lb., tare 1 qr. 26 lb., draft 2 lb. per barrel?
5. Find the net weight of 6 chests of tea weighing 7 cwt. 2 qr. 16 lb., tare 18 lb. per cwt.
6. Find the net weight and value of 7 barrels of figs, weighing each 3 cwt. 1 qr. 8 lb., tare 1 qr. 5 lb. per barrel, at 37s per cwt.
7. Find the net weight and value of 4 hhd. of sugar, each containing 10 cwt. 2 qr. 12 lb., tare 12 lb. per cwt., and draft 14 lb. per hhd. at 5d per lb.
8. Bought 15 pieces of cloth, containing 2112 yards, at 7⅛d, and am allowed 2 yards to every score I pay for; how much have I to pay?

BILLS OF PARCELS.

1. 10 yds. at £0 3 3¾ £
14 —— 0 3 7¾
16 —— 0 2 9½
£

2. 20 yds. at £0 4 7¼ £
30 —— 0 4 11½
40 —— 0 4 9¼
£

3. 26 yds. at £0 13 9½ £
37 —— 0 12 7¾
43 —— 0 11 0
£

4. 362 yds. at £0 10 7 £
473 —— 0 11 8¼
534 —— 0 12 3
£

5. 100 yds. at £0 16 4½ £
200 —— 0 17 6¼
100 —— 0 18 4¾
£

6. 150 yds. at £0 13 5¾ £
350 —— 0 14 7½
170 —— 0 15 9¼
£

7. 76 yds. at £0 7 5 £
100 —— 0 6 7¾
93 —— 0 19 7½
250 —— 0 15 4½
£

8. 39 yds. at £0 13 2 £
400 —— 0 16 7¾
87 —— 0 11 9
520 —— 0 13 11
£

9. 87 yds. at £2 5 0 £
78 —— 2 7 0
69 —— 2 16 0
39 —— 2 13 0
£

10. 245 yds. at £3 10 0 £
425 —— 3 12 0
524 —— 4 5 0
254 —— 5 13 4
£

11. 350 lbs. at £0 0 6¼ £
85 —— 0 0 4½
152 —— 0 0 3¾
521 —— 0 0 2¾
251 —— 0 0 4½
£

12. 75 lbs. at £0 0 5 £
363 —— 0 0 7
79 —— 0 0 11
426 —— 0 0 9
85 —— 0 0 8
£

13. 27 lbs. at £0 1 2¼ £
76 —— 0 1 5
230 —— 0 1 7
350 —— 0 11 9½
76 —— 0 12 3¾
£

14.	345	lbs. at	£0	2	7	£
	721	——	0	2	5	
	127	——	0	13	11	
	172	——	0	3	3	
	271	——	0	13	5	
						£

15.	67	lbs. at	£0	0	$5\frac{1}{2}$	£
	25	——	0	0	$6\frac{1}{4}$	
	33	——	0	0	$7\frac{3}{4}$	
	61	——	0	0	$8\frac{3}{4}$	
	236	——	0	0	$9\frac{3}{4}$	
						£

16.*	$\frac{1}{4}$	ton, at	£40	17	6	£
	$\frac{1}{3}$	——	39	13	4	
	$\frac{1}{5}$	——	49	17	6	
	$\frac{1}{6}$	——	81	10	10	
	$\frac{1}{8}$	——	66	16	7	
	$\frac{1}{12}$	——	99	19	2	
						£

17.	$\frac{3}{4}$	ton, at	£18	5	6	£
	$\frac{2}{3}$	——	21	10	7	
	$\frac{4}{5}$	——	15	13	7	
	$\frac{4}{5}$	——	6	9	6	
	$\frac{5}{6}$	——	25	18	4	
	$\frac{6}{7}$	——	16	19	10	
						£

18.	$\frac{3}{8}$	ton, at	£50	4	6	£
	$\frac{5}{12}$	——	83	10	0	
	$\frac{7}{12}$	——	12	15	6	
	$\frac{5}{12}$	——	18	18	8	
	$\frac{3}{8}$	——	19	19	9	
	$\frac{5}{8}$	——	73	7	6	
						£

19.	$6\frac{1}{4}$	yds. at	£0	6	7	£
	$7\frac{2}{3}$	——	0	9	8	
	$8\frac{3}{4}$	——	0	11	7	
	$10\frac{5}{8}$	——	0	15	9	
	$12\frac{1}{12}$	——	0	16	4	
	$3\frac{1}{6}$	——	0	18	9	
						£

20.	$37\frac{1}{4}$	yds. at	£1	7	7	£
	$64\frac{3}{8}$	——	1	19	4	
	$43\frac{3}{4}$	——	2	15	11	
	$54\frac{5}{12}$	——	3	7	8	
	$76\frac{2}{3}$	——	4	3	5	
						£

21.	$25\frac{1}{8}$	yds. at	£3	12	7	£
	$72\frac{11}{12}$	——	4	13	5	
	$76\frac{1}{4}$	——	2	17	9	
	$67\frac{5}{8}$	——	3	16	11	
	$53\frac{1}{5}$	——	1	18	8	
	$81\frac{7}{12}$	——	4	3	10	
						£

22.	45	yds. at	£2	5	0	£
	729	——	0	0	7	
	63	——	0	1	5	
	88	——	0	2	7	
	354	——	0	0	$5\frac{1}{2}$	
						£

23.	$\frac{3}{4}$	ton at	£18	18	0	£
	$\frac{7}{8}$	——	24	17	6	
	$5\frac{1}{2}$	——	11	11	6	
	$11\frac{1}{3}$	——	13	15	8	
	$367\frac{2}{3}$	——	0	10	10	
						£

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* In the succeeding accounts, reject fractions of farthings.

24.	100 yds. at	£0	6	7½	£	
	100 ——	0	16	4¾		
	106 ——	2	7	7¾		
	105 ——	0	11	3¼		
	150 ——	0	5	6¼		
	120 ——	2	17	10½		——
					£	

25.	155 yds. at	£0	14	5¾	£	
	200 ——	0	12	7½		
	600 ——	0	2	9¼		
	432 ——	0	3	4¾		
	543 ——	0	10	5½		
	654 ——	0	6	6½		
	765 ——	0	17	7¾		——

26.	564 lbs. at	£0	9	3½	£	
	675 ——	0	4	7½		
	342 ——	0	5	5½		
	604 ——	1	7	9¼		
	453 ——	0	2	11¼		
	754 ——	0	3	9¾		
					£	

27.	98 lbs. at	£7	5	9½	£	
	89 ——	1	15	3¾		
	97 ——	8	13	1¼		
	87 ——	1	14	3½		
	78 ——	3	3	7		
	79 ——	6	15	2½		
	87 ——	4	11	11		——
					£	

28.	371 lbs. at	£0	2	6	£	
	153 ——	0	17	6		
	96 ——	3	5	0		
	87 ——	2	16	0		
	63 ——	4	13	4		
	215 ——	7	2	0		——
					£	

29.	213 lbs. at	£0	0	6	£	
	317 ——	0	0	9		
	275 ——	0	3	6		
	157 ——	0	2	8		
	671 ——	0	13	4		
	397 ——	0	15	9		
					£	

FIND THE AMOUNT OF THE FOLLOWING.

30.	100	at £2	6	8,	100	at £3	18	0,	and	100	at £4	7	6
31.	100	2	16	5¼,	100	3	14	5.		100	4	17	11
32.	106	2	7	6¾,	106	4	19	10½,		108	3	16	6
33.	105	13	13	3,	103	7	17	1¾,		102	9	9	9
34.	150	21	5	6½,	160	2	11	5¼,		140	3	5	11
35.	120	2	17	11,	170	3	17	11¼,		130	4	17	11
36.	155	1	4	5¾,	132	1	2	6,		147	1	9	7
37.	200	3	16	7,	300	13	17	2,		400	15	3	9
38.	600	7	2	9,	604	2	7	9¼,		670	4	15	7
39.	432	12	3	4,	342	12	5	5½,		234	9	6	8
40.	543	13	10	5½,	453	11	2	11,		345	15	13	2
41.	654	15	16	8,	564	13	1	8,		456	11	17	6
42.	765	14	17	7¾,	675	19	18	4,		567	10	16	6
43.	987	17	5	9,	897	21	5	5¾,		789	8	13	1

First, multiply A. by 3, 4, and 5, separately, add the products together, and from their sum subtract D.

Second, multiply B. by 6 and by 7, separately, add the products together, and from their sum subtract D.

Third, multiply C. by 8 and by 9, separately, add the products together, and from their sum subtract D.

A.	B.	C.	D.
1. £1 2 11¾	26. £25 7 6½	51. £247 5 5	1 7 6¼
2. 1 4 9¾	27. 52 17 7¾	52. 427 7 7¼	13 10 9½
3. 2 7 7½	28. 27 7 11	53. 564 2 6	7 2 6¾
4. 2 17 8¼	29. 72 5 2	54. 465 8 11¾	18 11 11¼
5. 3 13 4¼	30. 68 13 4	55. 654 15 0	15 16 8½
6. 13 3 7¾	31. 86 5 11	56. 786 17 5¼	29 19 9¼
7. 6 15 2¼	32. 95 9 9	57. 876 17 6	9 17 7¾
8. 16 5 11½	33. 6 2 7	58. 678 15 0	5 13 3¼
9. 7 7 9¾	34. 20 15 11	59. 831 7 0	9 12 9¾
10. 12 14 4¼	35. 34 7 8	60. 138 19 7¾	7 16 4½
11. 4 9 7½	36. 65 16 10	61. 313 12 0	18 19 9½
12. 14 2 10¾	37. 56 17 9½	62. 331 16 10½	61 17 11¼
13. 15 3 11¼	38. 96 15 8½	63. 459 4 0	83 13 2½
14. 5 13 11½	39. 83 13 11	64. 549 8 11¾	48 15 5¾
15. 7 17 9¾	40. 95 17 7	65. 945 16 0	67 17 9½
16. 8 16 4¼	41. 65 16 8	66. 769 2 11½	98 17 11½
17. 10 10 6½	42. 83 13 9¾	67. 967 14 0	49 13 7¾
18. 15 15 4¾	43. 41 15 7½	68. 796 17 7¼	63 18 8¼
19. 26 16 7¾	44. 64 18 9	69. 834 13 0	39 19 9½
20. 6 17 6½	45. 97 17 5½	70. 384 19 10	57 11 2¾
21. 13 3 2¼	46. 95 15 10½	71. 141 15 6	0 15 11¾
22. 17 13 7½	47. 66 17 4½	72. 216 18 7	0 17 11
23. 21 7 9¼	48. 99 15 7	73. 319 19 9	10 19 9½
24. 27 17 11¼	49. 69 18 5¾	74. 527 13 4	65 0 11
25. 25 9 6¾	50. 65 11 11	75. 762 17 7	54 1 1

COMPOUND DIVISION.

Averages.

1. My house expenses in 4 weeks amounted to £11 3s 6d; how much was that a week?

2. If 5 quarters of wheat of various qualities sold for £14 1s 8d, what was *the average* price of each?

3. If a boy spent, during his holidays, or the months of August and September, £15 15s 2d, how much did he spend daily?

4. On Monday the thermometer stood at 60°, on Tuesday, at 56°, on Wednesday, at 52°, on Thursday, at 58°, on Friday, at 60°, and

on Saturday at 58°; what was the average heat of the atmosphere during these 6 days?

5. On Monday the barometer stood at 50°, on Tuesday, at 45°, on Wednesday, at 55°, and on Thursday, at 60°; what was the average pressure of the atmosphere during these 4 days?

6 What is the average value per box of 3 boxes of steel pens at 1s 6d, and 5 at 2s 6d?

7. One quarter of barley was bought for £1 15s, 2 quarters for £3 5s, and 5 quarters of another kind for £7; what was the *average price* per quarter of the whole?

8. The weight of 4 bushels of one quality of wheat was 18 stones 8 lbs., and 4 bushels of an inferior kind weighed 17 stones 10 lbs.; what was the average weight per bushel of the whole?

9. A merchant's gain the first week of January amounted to £13 5s 6d, the second week it amounted to £12 10s 6d, and he gained in the next fortnight £23 17s 9d; what was his average gain in each of the four weeks of January?

10. A gentlemen's annual income is £3500, of which he saved last year £1500; what was his average weekly expenditure?

11. 7 sacks of flour were brought to market, whereof 2 sold at 39s per sack, 2 at 35s per sack, and 2 at 34s per sack; find the average price of the 6 sacks that were sold.

12. What is the average price per quarter of 300 quarters wheat, sold at 70s per quarter, 260 quarters at 50s, and 270 quarters at 60s?

13. 41 sacks of barley were brought to market, whereof 33 sold as under:

1 at	£2	1	0	per quarter.	4 at	£1	8	6	per quarter.
1	1	12	0	——	3	1	8	0	——
7	1	11	0	——	9	1	7	6	——
6	1	10	0	——	2	1	6	6	——

find the average price per sack of the 33 quarters which were sold.

14. What is the average value per quarter of 12 quarters wheat at £2 18s; 32 quarters at £2 17s; 21 quarters at £2 16s; 10 quarters at £2 15s 6d; 26 quarters at £2 15s; 31 quarters at £2 14s; 23 quarters at £2 13s; 20 quarters at £2 12s 6d; 82 quarters at £2 12s; 34 quarters at £2 11s; 10 quarters at £2 10s 6d; 63 quarters at £2 10s; 3 quarters at £2 8s; and 8 quarters at £2 7s?

15. A merchant's gain each of the four quarters of the year was as follows:—viz., 1st quarter, £729 10s 6d; 2d quarter, £360 17s 11d; 3d quarter, £472 18s 11¾d; and the 4th quarter it amounted to £648 10s 10d. In the 3d quarter he lost, by a joint adventure to Sydney, £518 10s 7d; and his loss by bad debts and otherwise amounted to £357 17s 4½d. Out of his net gain he purchased a

house, for which he paid £646 11s 3d, including his half share of the expense of transfer. He spent the rest; what was his monthly and daily average expenditure?

A PREPARATION FOR COMMISSION AND INTEREST.

1. £1234 5 6 ÷ 100
2. 5678 9 10 × 2 ÷ 100
3. 7890 11 1 × 3 ÷ 100
4. 456 15 6 × 5 ÷ 100
5. 675 17 8 × 6 ÷ 100
6. 7531 18 6 × $\frac{1}{2}$ ÷ 100
7. 3456 17 7 × $\frac{1}{3}$ ÷ 100*
8. 8700 15 10 × $\frac{1}{5}$ ÷ 100
9. £8123 1 11 × $\frac{1}{6}$ ÷ 100
10. 31415 10 6 × $\frac{1}{8}$ ÷ 100
11. 42525 11 7 × $\frac{1}{12}$ ÷ 100
12. 8765 18 4 × $\frac{1}{20}$ ÷ 100
13. 6000 10 5 × $\frac{3}{4}$ ÷ 100
14. 5400 12 6 × $\frac{3}{8}$ ÷ 100
15. 9835 15 2 × $\frac{5}{12}$ ÷ 100
16. 8953 18 8 × $\frac{11}{12}$ ÷ 100

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17. £155 16 7 × $1\frac{1}{2}$ ÷ 100
18. 451 5 0 × $2\frac{1}{4}$ ÷ 100
19. 256 17 6 × $3\frac{1}{2}$ ÷ 100
20. 983 10 11 × $4\frac{1}{2}$ ÷ 100
21. £256 15 0 × $3\frac{2}{3}$ × 3 ÷ 100
22. 983 15 0 × $4\frac{3}{4}$ × 5 ÷ 100
23. 389 15 0 × $2\frac{3}{4}$ × $1\frac{1}{2}$ ÷ 100
24. 261 15 0 × $5\frac{3}{4}$ × $2\frac{3}{4}$ ÷ 100

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25. £745 13 6 × 27 × 4 ÷ 73000
26. 1394 11 7 × 29 × 4 ÷ 73000
27. 561 9 7 × 41 × 5 ÷ 73000
28. 489 19 9 × 57 × 7 ÷ 73000
29. 984 17 10 × 210 × 8 ÷ 73000
30. 9120 15 4 × 60 × $5\frac{3}{4}$ ÷ 73000
31. 7560 15 9 × 183 × $7\frac{1}{2}$ ÷ 73000
32. 989 10 11 × 265 × $7\frac{3}{4}$ ÷ 73000
33. 5070 11 10 × 125 × $9\frac{1}{2}$ ÷ 73000
34. 733 18 0 × 345 × $9\frac{3}{4}$ ÷ 73000

Find the number of days, including the last only—

35. Between Feb. 2 and Mar. 25
36. ——— May 15 and June 24
37. ——— Aug. 1 and Sept. 29
38. ——— Nov. 11 and Dec. 25
39. ——— Feb. 2 and May 15
40. ——— May 15 and Aug. 1
41. ——— Aug. 1 and Nov. 11
42. ——— Mar. 25 and May 25
43. Between April 5 and Oct. 10
44. ——— Oct. 10 and April 5
45. ——— Jan. 5 and July 5
46. ——— July 5 and Jan. 5
47. ——— Jan. 5 and April 5
48. ——— July 5 and Oct. 10
49. ——— Oct. 31 and Jan. 5
50. ——— May 15 and July 5

* Should the fraction of a farthing occur, reject it.

51.	Multiply	£68	15	6	by the days between	Oct. 1 and Dec. 15
52.	——	16	10	11½	——	Dec. 15 and Mar. 1
53.	——	19	10	11¾	——	Mar. 1 and July 31
54.	——	34	11	10	——	July 31 and Sept. 30
55.	——	73	12	6	——	Sept. 30 and Dec. 31
56.	——	39	18	8	——	Nov. 16 and Mar. 2
57.	——	38	15	5	——	Nov. 21 and June 11
58.	——	72	17	7	——	Mar. 17 and Nov. 15
59.	——	83	5	11	——	Jan. 11 and Oct. 1
60.	——	61	19	4½	——	Feb. 7 and Dec. 17
61.	——	39	17	5¾	——	May 1 and Dec. 31
62.	——	93	14	4½	——	June 3 and Nov. 30
63.	——	59	17	11¼	——	April 16 and Oct. 21
64.	——	356	17	2½	——	Nov. 17 and Dec. 31
65.	——	536	15	11	——	Oct. 15 and Dec. 31
66.	——	653	11	10¾	——	Sept. 17 and Dec. 31
67.	——	240	19	1	——	Aug. 11 and Dec. 31
68.	——	753	14	9¾	——	July 31 and Dec. 31

Should the fraction of a farthing occur, reject it.

SIMPLE PROPORTION.

Rule for Stating.

(1) Place that term *third* which is of the same kind as the one required; (2) then, if the answer is to be *greater* than the third term, place the greater of the other two *second*, and the less first; but if the answer is to be *less* than the third term, place the less of the other two *second*, and the greater first.

Question.

How do you distinguish the third term?

Answer.

By its being of the same kind as the answer.

Question.

Do you know when to place the greater, and when the less, of the two remaining terms second?

Answer.

The greater is placed second when the answer is to be greater than the third term, but the less is placed second when the answer is to be less.

RULE FOR FINDING THE FOURTH PROPORTIONAL, OR RULE FOR WORKING.

(1) Multiply the second and third terms together; (2) divide their product by the first

An Analysis of the Questions in Proportion.

The following exercises in Proportion are divided into three sections.

THE FIRST SECTION

Is divided into three divisions, illustrating, in the first division, the case in which all the terms are simple, the first and second in the same name, and the first prime to the second and to the third.

Rule I.

(1) Multiply the second and third terms together; (2) divide their product by the first.

Second Division.

The case in which the terms, as before, are all simple, and the first and second in the same name, but the ***first*** not prime to the second and third.

Rule II.

Make the first prime to the second and third (that is, cancel), and then apply the Rule for working.

Third Division.

The case in which the first and second terms are not in the same name, or when the first or second, or both, are compound numbers.

Rule III.

(1) Reduce the first and second to the same name, (2) cancel, if possible, and (3) then apply the Rule for working.

THE SECOND SECTION—*In Three Divisions,*

Illustrating how the product of the second and third terms is to be found in all cases in which the latter is compound.

First Division.

The Product should be found by—COMPOUND OR SIMPLE REDUCTION.

In every case, except those in the two following Divisions, the product should either be found by Compound Reduction, or the third term should be reduced to its lowest name, and the product found by Simple Multiplication.

Second Division.

The Product should be found by—COMPOUND MULTIPLICATION.

Compound Multiplication appears to be the shortest method when the second term is not above 12, or when it is a composite number, not exceeding 144, neither of the factors of which is above 12.

Third Division.

The Product should be found by—PRACTICE.

Practice is evidently the shortest method when the third term is one of the Practice class of prices, for which see pages 79 to 84, or in the case of its being a weight or measure, when the lower denominations are an aliquot part of the higher.

THE THIRD SECTION—*In Five Divisions*,

Will illustrate those cases occurring most frequently, in which the pupil usually finds difficulty in stating the question, without some assistance, in the first instance, from the teacher.

First Division

Consists of questions in Inverse proportion.

Second Division

Consists of questions in which a number occurs, not forming a part of the statement.

Third Division,

Questions in which the three terms are in one name.

Fourth Division,

Questions in which one of the terms is to be found from the terms of the question by Multiplication, or some other process.

Fifth Division,

Questions in which the answer to the proportion is not the answer to the question, but from which, together with the data of the question, the answer is generally easily found.

FIRST SECTION.

FIRST DIVISION.

The case in which all the terms are simple, the first and the second in the same name, and the first prime to the second and to the third.

NOTE.—The second condition is essential to the Proportion, and the third is *desirable*, as in this state the fourth term will generally be found more easily than when the first term is not prime to the second and third.

1. If 3 yards cost 13s, what will 4 yards cost?
2. If 5 yards cost 13s, what will 4 yards cost?

3. If 6 yards cost 25s, what will 7 yards cost?
4. If 8 yards cost 25s, what will 7 yards cost?
5. How many yards of cloth may be purchased for £9, the price of 69 yards being £16?
6. How many cwt. may be purchased for £9, the value of 69 cwt. being £7?
7. 207s was the value of 8 yards, how much should be paid for 37 yards?
8. If 16 yards cost 207s, what is the value of 11 yards?
9. The prime cost of 32 bushels is 197s, *find* the prime cost of 29 bushels.
10. Find what 41 stones of hay should be sold for, when 27 stones cost 19s.
11. If 27 yards of linen are valued at 95s, what should be paid for 14 yards of it?
12. If 41 yards cost £18, how much is 35 yards of the same worth?
13. Lost £18 upon 56 tons of iron, calculate the loss upon 413 tons.
14. A farm of 377 acres was let for £1504, what part of it should be let at the same rate for £293?
15. If 67 men can earn £29 in a certain time, how much will 18 men earn in that time?
16. If 37 yards be valued at £9, what will 98 yards of the same cost?
17. Exercises on the working of the above—

1. 23 : 30 : : 375 cwt.
2. 29 : 80 : : 759 qrs. barley.
3. 181 : 376 : : 67 acres.
4. 283 : 759 : : 79 acres.

NOTE.—As the object of the two first sections is to train the pupil to the *working* of the proportion, we think it desirable, in the accounts of these sections, to cause him to reduce the remainder of the answer to the lowest denomination of the table to which it belongs.

The pupil should *revise* this division before passing on to the next.

SECOND DIVISION.

The case in which the terms, as before, are all simple, and the first and second in the same name, but the first not prime to the second and third.

18. If 5 yards of silk cost 16s, what will 25 yards cost?*

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* If the terms are perceived to be in the relation of multiple and submultiple before they are stated, the answer should be found either by multiplication or division, without stating. From this account onwards, the remainder should be expressed in its lowest terms.

19. If £47 be the price of 81 yards of satin, what should 9 yards cost?

20. £7 was paid for 15 yards, find the value, at that rate, of 60 yards.

21. When 121 tons cost £80, how much should be paid for 11 tons?

22. 49 cwt. having been bought for £96, how much may be bought for £16?

23. Valued 36 yards of cloth at £33, what should be the value of 26 yards?

24. If 32 yards cost £48, how many yards should I get for £44?

25. Find the value of 48 tons, at the rate of £51 for 60 tons.

26. Find the duty on 799 gallons of port wine, £49 being the duty on 504 gallons.

27. If 2408 cwt. of sugar cost £7200, how much should be charged for 4480 cwt.?

28. 352 cwt. of iron would at present be worth £181, what is the present value of 484 cwt. of the same?

29. Exercises on Cancelling—

1. 164 : 292 : : 45 tons.
2. 315 : 725 : : 79 oz. troy,
3. 1173 : 1248 : : 60 miles.
4. 680 : 1736 : : £48.
5. 3771 : 2916 : : £41.
6. 5632 : 517 : : £92.
7. 369 : 351 : : 673 acres.
8. 1067 : 495 : : 579 lbs. tr.
9. 2536 : 456 : : 238 pecks.
10. 3378 : 1278 : : 329 frlngs.
11. 4362 : 2070 : : 575 cwt.
12. 1940 : 1644 : : £849.

THIRD DIVISION.

The cases in which the first and second terms, though simple, are not in the same name, or in which the first or second, or both, are compound numbers.

30. Find the price of 56 English ells of silk, 16s having been paid for 7 quarters of the same.

31. 803 stones of potatoes sold for £35, how much should 11 tons cost?

32. A property of 88 acres was valued at £7953, how much should 315 perches cost?

33. If 122 yards 1 nail of silk velvet cost £61, how much should be paid for 47 yards 1 quarter?

34. If the present value of 318 cwt. of lead is £246, how much may be bought for £65 2s 9d?

35. Sold 316 lbs. of cochineal for £124, how much must I sell before I draw £1560 17s 11d?

36. If 234 yards 3 quarters 3 nails cost £117, how much should 238 yards 3 quarters 2 nails cost?

37. 415 cwt. 1 quarter of copper being equal to 469 quarters of wheat, how much wheat should be given in exchange for 189 cwt. 3 qrs. 8 lbs. 4 ounces of copper?

38. How much should be charged for a small field, measuring 2 acres 3 roods 19 perches, at the rate of £31,255 for 417 acres?

39. If 500 ounces of standard gold discharge a debt of £1945 16s 8d, how many ounces would be necessary to pay a debt of £324 19s 3d?

40. Find how much should be paid for 361 yards of cloth, at the rate of 1698 yards for £153.

41. A farmer brought to market 98 quarters of barley, valued at £144, whereof 77⅛ quarters were sold, how much money did the farmer draw?

42. Exercises on the reduction of the first and second terms.

1. 39 dwt. : 29 ounces : : 45s.
2. 276 cwt. : 197 cwt. 20 lbs. : : £60.
3. 41 yards 11 inches : 37 miles 2 furlongs : : 8d.
4. 15 quarters : 3728 bushels : : £18.
5. 3 gallons 1 quart : 3 quarts 1 pint : : 745 dwt.
6. £9 17s 5d : £23 18s 11¼d : : 27 miles.
7. £93 0s 0¾d ; £654 : : 217 days.
8. 25 guineas ; £8 11s 6d : : 839 cwt.

THE SECOND SECTION

Is intended to illustrate how the product of the second and third terms is to be found in all cases in which the latter is compound.

First Division.

The case in which the product should be found by Compound or Simple Reduction.

43. If 5 tons cost £36 3s 5d how much should 68 tons 19 cwt. cost?

44. If 45 yards are worth £121 3s, what is the value of 371 yards?

45. 1000 tons being worth £5393 7s 4½d, how much should be paid for 939 tons?

46. If 27 cwt. 3 qrs. 20 lbs. be purchased for £181 13s, how much may be obtained for £97 7s 9d?

47. If the rent of a farm of 220 acres 31 perches is £600 17s 5d, what should be the rent of a farm of 108 acres 1 rood 26 perches, at the same rate?

48. Find the value of 719 lbs. of cochineal, at £106 3s 9¾d for 354 lbs.

49. Exercises on finding the product of the second and third terms by *Reduction.*

1. 7944 : 8916 : : £0 15 6¼
2. 5992 : 5040 : : 0 17 2¾
3. 2250 : 2439 : : 3 6 5
4. 85968 : 138240 : : 2 11 7
5. 4494 : 8904 : : 15 yards 1 quarter 3 nails.
6. 30105 : 4415 : : 17 cwt. 3 quarters 22 pounds.
7. £17 10s 4¾d : £10 16s 6¾d : : 27 yards 2 feet 5 inches.
8. 10 cwt. : 15 cwt. 21 pounds : : 37 quarters 3 bushels 3 pecks.
9. 896 cwt. 1 qr. 20 lbs. : 2681 cwt. 1 qr. : : 2 ro. 27 per. 14¼ yds.
10. 65968 ; 74192 : : 3 roods 5 perches 21¾ yards.
11. £78 5s 8d : £59 11s 10¾d : : £6 14s 7¾d.
12. 104 oz. 3 dwt. 9 grains : 8 oz. 3 grains : : £12 9s 9½d.

SECOND DIVISION.

The case in which the product should be found by Compound Multiplication.

50. If 7 yards of cloth cost £6 13s 4¼d, how much should be paid for 9 yards of the same?

51. If 76 yards of lace be valued at £43 13s 11d, how much should be paid for 45 yards of the same?

52. What should be paid for 28 lbs. of sago, when 16s 11½d is charged for 57 lbs.?

53. When the price of 4 cwt. 27 lbs. of loaf sugar is £19 15s 7½d, how much should be paid for 300 lbs of it?

54. £6 6s having been charged for 36 yards 3 quarters 2 nails of linen, how much should I get for £8 2s?

55. If 11 ounces of gold be worth £42 16s 5d, what will be the value of a bar weighing 40 ounces?

56. If a bar of gold, weighing 51 ounces, cost £198 9s 7d, how much should be paid for one weighing 28 ounces?

57. Sold 11 ounces 15 dwts of platinum for £21 13s 6d, how much should I charge for 6 ounces 13 dwt. 8 grains?

58. If £75 10s 3½d be the value of 25 pounds 2 ounces 8 dwt. of silver, how much should be paid for 52 lbs 6 ounces?

59. 239 yards 1 nail of cloth being reckoned equal in value to 73 quarters 7 bushels 3 pecks of wheat, how much wheat ought, at this rate, to be given for 185 yards 2 quarters 2 nails of such cloth?

60. If 20 cwt. 14 pounds of iron cost £10 11s 8d, how much is 15 cwt. worth?

61. **Exercises on finding the product of the second and third terms by *Compound Multiplication*.**

1. 864 : 1680 : : 71 acres 3 roods 29 perches.
2. 16704 : 153 : : 13 gallons 2 quarts 1 pint.
3. £8 18s 6d : £3 15s : : 741 yards 3 quarters 2 nails.
4. 3 acres 2 roods 34 per. : 5 acres 2 roods 20 per. : : £362 13s 7d.

THIRD DIVISION.

The case in which the product should be found by one of the Practice methods, see pages 79 to 84.

62. If 335 pounds of cochineal be worth £91 6s 8d, what is the value of 187 pounds?

63. When the price of 97 pounds of safflower is £12 6s 8d, how much should be paid for 3 cwt. 3 quarters 16 pounds of it?

64. 61 cwt. of logwood cost £49 17s 6d, how much should be paid for 319 cwt.?

65. If 3 tons 4 cwt. 14 pounds of lead be worth £57 13s 4d, how much is 4 tons 17 cwt. 1 quarter 7 pounds worth?

66. Exercises on finding the product of the second and third terms by *Practice*.

1. 582 : 1344 : : 6s 4d.
2. 1120 : 1511 : : 7s 8d.
3. 36 cwt. 3 quarters 9 lbs. : 220 cwt. 3 qrs. 21 lbs. : : £3 3s 4d.
4. 404 yards 1 nail : 458 yards 1 quarter 3 nails : : £6 2s 6d.
5. 7 acres : 1 rood 12 perches 6 yards : : £15 13s 4d.
6. 12 acres 15 perches 14 yards : 35 acres 39 per. : : £29 17s 6d.
7. £490 11s 1d : £303 5s 5d : : 15 cwt. 16 pounds.
8. 4720 : 4864 : : 32 acres 20 perches.
9. £37 3s : £33 2s : : 27 acres 3 roods 20 perches.
10. 1645 : 2779 : : 45 pounds 4 ounces troy.
11. 8151 : 6017 : : 63 pounds 8 ounces troy.
12. 4050 : 1197 : : 45 pounds 10 ounces 10 dwt. troy.

THIRD SECTION.

FIRST DIVISION.—INVERSE PROPORTION.

67. If 45 men can perform a piece of work in 30 days, how many men must be employed to do the same in 18 days?

68. In what time will 325 men do what 405 men can do in 120 days?

69. If 35 barrels, of 32 gallons, hold a brewing of ale, how many barrels of 36 gallons would have held it?

70. How many yards of cloth, at 18s 6d, are equal in value to 1025 yards at 14s 9d?

71. How many pounds of annatto, at 2s 3½d a pound, should be given in exchange for 125 pounds of Bengal indigo, at 7s 11d a pound?

72. How many gallons at 11s 6d will come to as much money as 260 gallons at 14s 9d?

73. How many ounces of gold, 18 carats fine, may be had for 11 ounces 18 dwt. 15 grains of standard purity, which is 22 carats fine?

74. If 145 men can build a certain house in 25 weeks, how many men could build it in 12 weeks and 3 days?

75. What sum of money, in four months, will yield as much interest as £376 15s 8½d in ten months?

76. If my friend lends me £1000 for 11 months, how much should I lend him for 5 months, to return the obligation?

77. If I lend my friend £1000 for 5 months, how much should he lend me for 11 months to return the obligation?

78. If a person, walking nine hours a day, can perform a journey in 18 days, how many hours a day must he walk to return in 15 days?

79. A cistern has 2 cranes, A and B. A discharges 5 gallons 2 quarts in a minute, and empties the cistern in 15 minutes 20 seconds; how much does B discharge in a minute, if it takes 20 minutes 15 seconds to empty the cistern?

SECOND DIVISION.

One or more numbers occur, not required in the stating.

80. If the price of 75 yards 5 quarters wide be £15 3s 4d, how much should be paid for 47 yards of the same?

81. If 25 pieces of cloth, containing 953 yards, are valued at £154 17s 9¼d, how much should 3 pieces, containing 108 yards cost, at the same rate?

82. If a person travelling 14 hours a day, finish the *first half* of a journey in nine days, in how many days will he finish the *remaining half*, travelling 10 hours per day at the same rate?

83. If 95 men consume 828 stones 8 pounds of beef in 3 months, how much will 365 men require in the same time?

84. 25 cwt. 3 qrs. 17 lbs. of sheet lead, measuring 359 feet, cost £50 18s 9d, how much should be paid for 17 cwt. 1 qr. 23 lbs.?

Questions in which the three terms are in one name.

85. Required the length of a piece of carpet 1 yard 1 quarter 2 nails wide, which shall cover the same surface as another piece 80 yards long and 3 quarters 8 nails wide?

86. 5 acres 2 roods 25 perches of arable land being thought equal in value to 10 acres 1 rood 35 perches of pasturage, how much arable land, at that rate, ought to be given for a square mile of pasturage?

87. How much cloth, 5 quarters 3 nails wide, is equal in value to 509 yards 3 quarters of the same quality, 3 quarters 1 nail wide?

88. If 175 ounces troy are equal to 192 ounces avoirdupois, how many ounces avoirdupois are there in 270¾ ounces troy?

89. A man 6 feet high casts a shadow of 7 feet 10 inches, what is the height of an object, which, at the same time, casts a shadow of 1000 feet 6 inches?

90. If 175 ounces troy are equal to 192 ounces avoirdupois, how many ounces troy are equal to 270¾ ounces avoirdupois?

91. "A grocer, bartering with a clothier, charges 6s 4d for tea which cost him only 5s 8d; what should the clothier charge for cloth which cost him 8s 6d, to be no loser in the transaction?"

92. If the interest on £215 18s 6d be £9 6s 8d, how much is that for £100?

The pupil should now pass on to Interest and the first course of Fractions, after which he may return and do the two following sections:—

One or more of the terms is to be found by addition, or some other process.

93. A clerk entered on his duties on the 1st of January, at a salary of £150 a year; he left on the 15th of September; how much is due to him, including both days?

94. If 18 men can execute a certain work in 5 days of 10 hours each, how many men must be employed to do it in 36 hours?

95. A spirit merchant has 80 gallons 1 quart of whisky, which is worth £45 13s 4d; he mixes with it 10 gallons 3 quarts 1 pint of water; required the value of 25 gallons 1 quart of the *reduced* spirit.

96. A spirit merchant has 50 gallons of brandy, which he commonly sells at 27s 6d a gallon, he adds to it 6 gallons of water; how much should he charge for 30 gallons of the reduced spirit?

97. A merchant bought 100 gallons of whisky at 9s 6d a gallon, to which he adds 20 gallons of water; how much must he charge for 40 gallons of the reduced spirit, so as to gain 5 guineas on the whole?

98. A corn merchant buys 197 quarters 2 bushels of oats for £250, which, having received damage in his possession, he is wil-

ling to sell at a loss of £50; how much should be charged for 85 quarters 7 bushels, at this rate?

99. A vessel containing 509 gallons 3 quarts, in 7 minutes discharges 80 gallons; in what time would it be emptied, if there flowed into it 60 gallons every 7 minutes?

100. If 5 hhds. of sugar, each weighing, on an average, 12 cwt. 15 lbs. nett, are bought for £125 17s 6d, how much is 30 cwt. 3 qrs. 25 lbs. of it worth?

101. How much black cloth, at 25s 9d a yard, should be given in barter for 15 pieces of linen, each containing 24¼ yards at 3s 9d a yard?

102. Bought 25 yards 2 qrs. of silk velvet for £11 12s 6d, on which I wish to gain £2 10s; what will be the selling price of a a piece measuring 8 yards 3 nails?

103. The rent of a farm of 130 acres is £520 a year; what should be its yearly rental when three fields are taken from it, each measuring 6 acres 1 rood 15 poles?

104. From a piece of cloth measuring 36 yards 1 quarter 2 nails, worth £20 17s 6d, I sold a part for £13 19s 1½d, at the same rate, how much is on hand?

105. It was calculated that 15 men would cut down a crop of wheat in a week, but 6 of them having been otherwise employed, in how many days will the remainder cut down the wheat?

106. A vessel with a crew of 15 men have provisions for 120 days at the rate of 50 lbs. a-day. During the voyage they pick up 6 men from a wreck; to what must the ship's daily allowance be reduced, that these men may be supported?

Questions in which the answer to the proportion is not the answer to the question.

107. 10 joiners can execute the wood-work of a house in a fortnight, working 10 hours a day; how many *additional* hours per day must they work to have it finished in nine days?

108. A gentleman spends £50 17s 9¼d between the 1st of June and the 15th of August, including both days; now, supposing his income to be £350 per annum, at the above rate of expenditure, whether would he save or run in debt, and to what extent in the course of a year?

109. "A farmer computed that 16 shearers would cut down his crop in 23 days; but, finding his corn ripe, and dreading an alteration of weather, resolves, after 8 days' work, to have the remainder cut down in 6 days; how many *additional* reapers must he procure for that purpose?"

110. An agent, who is allowed 4½ per cent. commission sold

goods last year to the amount of £20965 18s 8d, but his losses by bad debts amounted to £650 11s 11½d; required his nett income.

111. Bought 50 quarters of wheat for £109 17s 6d; what must I charge for 23 quarters of it, so as to gain 10 guineas by the sale?

112. Bought 75 bags of sugar for £190 13s 6d, four bags of which having received damage, I sold at a loss of £3 15s, how much were they sold for?

COMPOUND PROPORTION.

RULE FOR STATING.

Place that term third which is of the same kind as the one required; then take any two like terms, and the third term, and state as in simple proportion, *without reference to any of the other terms*. Treat each like pair in like manner, placing them under the former. Reduce each pair to one denomination, and divide the product of the second and third terms by the product of the first terms.

Ex.—If 9 men can make a road 4 miles long in 18 days, how many men will make a road 12 miles long in 27 days?

$$\begin{array}{l} 4 \ : 12 :: \overset{\text{Men}}{9} \\ 27 : 18 \end{array} = \frac{\overset{\cancel{3}}{\cancel{12}} \times \cancel{9} \times 18}{\cancel{4} \times \underset{\cancel{3}}{\cancel{27}}} = 18 \text{ Men.}$$

1. If 42 men can do a piece of work in 12 weeks, working 10 hours a day, how many men must be employed to do a similar piece of work in 7 weeks, working 8 hours a day?

2. How many days will 10 men require to make 46½ reams of paper, working 12 hours a day, when 15 men, working 11 hours a day, take 9 days to make 54¼ reams?

3. A person deposited a certain sum of money in a bank, and upon drawing it out at the end of 7 months, received for interest £13½ at the rate of 4 per cent. How much money was deposited?

4. Suppose it requires 40 men to cut down 250 acres in 20 days, how many acres will 17 men cut down in 34 days?

5. A field of 16 acres can be ploughed in 7 days by 14 horses, in what time could a field of 9 acres be ploughed by 18 horses?

6. Calculate the interest on £415 for 21 days, at the rate of 5 per cent.

7. Received £16 for the use of £500, for the first 4 months of the year, at what rate per cent. was my money lent?

8. If a vessel 12 feet long, 8 feet wide, and 1 foot 7½ inches deep contains 960 gallons, what must be the depth of a vessel which is to be 4 feet long and 3 feet wide, to contain 100 gallons?

9. If 112 men can cut down 460 acres, 3 roods, 8 poles in 6 days, how many men will cut down 72 acres in 5 days?

10. If the carriage of 15 cwt. for 7½ miles is £2 14s 4½d, how far ought 40 cwt. to be carried for £14 10s?

11. If the 4 lb. loaf sells at 8d when wheat sells at 54s per quarter, what ought the 6d loaf to weigh when wheat sells at 84s per quarter?

12. If the 8d loaf weighs 4 lbs. when wheat sells at 50s a qr., what should be the price of wheat when the 6d loaf weighs 2 lbs. 4½ ounces?

13. If 3 men can mow 14 acres of grass in 5 days of 9 hours each, in how many days of 10 hours each, will 5 men mow 35 acres?

14. If the 4d loaf weighs 24 oz. when wheat sells at 56s per qr., what is the price of wheat when the 6d loaf weighs 30 oz?

15. If 780 men on full rations consume 221 quarters of wheat in 119 days, how many on half rations will consume 437 quarters in 57 days?

COMMISSION AND INTEREST.

SECTION I.—To find the commission on any sum of money, or the interest for one year.*

Rule.—(1). Multiply the principal by the rate per cent.
(2). Divide the product by 100.

SECTION II.—To find the interest on any sum of money for a number of years.

Rule.—(1). Multiply the principal by the number of years.
(2). Multiply this product by the rate per cent.
(3). Divide the last product by 100.

SECTION III.—To find the interest on a sum of money for a number of months, or years and months.

Rule.—(1) Reduce the months to the fraction of a year, and the years and months to a mixed number of years.
(2). Multiply the principal by this fraction or mixed number.
(3). Multiply the product by the rate per cent.
(4). Divide the last product by 100.

Note.—Multiply by the fraction or mixed number according to the methods at page 61.

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* In all interest calculations, reject the fraction of a farthing.

SECTION IV.—To find the interest on a sum of money for a number of days.

Rule I.—(1). Multiply the principal by the number of days.
(2). Multiply this product by double the rate per cent.
(3). Divide the last product by 73000.

Rule II.—(1). Multiply the number of days by double the rate per cent.
(2). Multiply the product by the principal (Compound Reduction).
(3). Divide the last product by 73000.

Note.—The money lent is called the *principal*, and the *sum* of the *interest* and principal is called the *amount*.

SECTION I.—Find the commission or the interest for one year on

1. £865 10 6 at 3 per cent.
2. 750 11 2 2 “
3. 960 17 1 3 “
4. 678 14 9 3 “
5. 937 5 6 2 “
6. 678 7 6 $2\frac{1}{3}$ “
7. 931 11 3 $2\frac{1}{2}$ “
8. 345 3 8 5 “
9. 1679 13 9 5 “
10. 2981 0 0 $\frac{1}{3}$ “
11. 3438 0 0 $\frac{1}{2}$ “
12. 4397 0 0 $\frac{1}{4}$ “
13. 5291 0 9 $\frac{1}{4}$ “
14. 6713 1 6 $\frac{1}{6}$ “
15. 7819 11 11 $\frac{1}{8}$ “
16. £716 0 0 at 5 per cent.
17. 917 10 6 4 “
18. 97 11 7 $4\frac{1}{2}$ “
19. 67 17 9 $5\frac{1}{2}$ “
20. 99 19 11 $3\frac{1}{2}$ “
21. 69 18 11 $2\frac{1}{3}$ “
22. 61 15 2 $3\frac{1}{4}$ “
23. 213 11 11 $4\frac{1}{4}$ “
24. 371 9 9 $\frac{1}{8}$ “
25. 979 9 11 $\frac{1}{8}$ “
26. 99 12 6 $\frac{1}{12}$ “
27. 97 16 9 $2\frac{1}{8}$ “
28. 176 13 10 $3\frac{1}{12}$ “
29. 970 19 1 $3\frac{1}{8}$ “
30. 775 13 4 $3\frac{1}{8}$ “

SECTION II.—To find the interest for a number of years.

Find the interest on

Per Cent.
31. £72 18 0 for 2 years at 1
32. 96 15 0 — 3 “ 6
33. 68 19 0 — 4 “ 5
34. 83 13 0 — 5 “ 4
35. 27 14 0 — $2\frac{1}{2}$ “ 7
36. 87 12 0 — $3\frac{1}{2}$ “ 8
37. 78 10 0 — $4\frac{1}{3}$ “ 3
38. 120 13 0 — $5\frac{1}{8}$ “ 7

Per Cent.
39. £118 15 7 for 3 yrs. at $4\frac{1}{2}$
40. 281 12 6 — 7 “ $2\frac{1}{3}$
41. 119 13 8 — $1\frac{1}{4}$ “ $5\frac{1}{2}$
42. 140 7 7 — $10\frac{1}{2}$ “ 6
43. 138 9 5 — $2\frac{3}{4}$ “ $4\frac{1}{2}$
44. 150 10 2 — $4\frac{5}{12}$ “ $3\frac{4}{5}$
45. 240 11 11 — $5\frac{7}{12}$ “ $7\frac{3}{4}$
46. 354 5 6 — $6\frac{7}{12}$ “ $8\frac{3}{4}$

THIRD SECTION.

To find the interest for a number of months, and for a number of years and months.

Find the Interest due on

Months. Per Ct.

1. £349 1 11½ for 6 at 4
2. 471 2 9¼ — 4 — 5
3. 558 11 7¾ — 2 — 6
4. 637 12 5¾ — 3 — 3
5. 791 3 3¾ — 1 — 4
6. 763 4 1 — 1 — 7
7. 131 13 10¾ — 8 — 2
8. 140 14 8 — 9 — 5
9. 150 5 6¾ —10 — 1
10. 236 6 4 —10 — 4
11. 348 15 3¼ —11 — 3
12. 567 16 2 — 5 — 5
13. 783 7 1¾ — 5 — 4
14. 384 8 2 — 7 — 5
15. 269 17 3¾ — 7 — 6
16. 962 18 4 — 7 — 7¾

Per Cent.

17. £89 12 1 for 3 y. 3 mo. at 4
18. 75 12 4 — 3 y. 9 mo. — 5
19. 55 13 8 — 2 y. 4 mo — 7½
20. 95 13 7¾ — 2 y. 8 mo. — 4
21. 68 14 5½ — 5 y. 2 mo. — 2½
22. 48 14 4½ — 5 y. 10 mo. — 3
23. 178 15 8 — 6 y. 1 mo. — 4⅓
24. 167 15 9 — 6 y. 11 mo. — 5
25. 79 10 3 — 2½ mo. — 3
26. 49 10 7 — 4⅓ mo. — 4
27. 59 11 8 — 5¼ mo. — 5
28. 69 11 6 — 3⅔ mo. — 3
29. 276 17 3 — 4⅜ mo. — 5
30. 397 17 2¾ — 7⅝ mo. — 6
31. 437 19 10½ — 10 5/12 mo. — 5
32. 573 1 11¼ — 3 7/12 mo. — 5

FOURTH SECTION.

To find the Interest for a number of days.

Find the Interest due on

Per Cent.

33. £451 0 0 for 10 days at 6
34. 542 0 0 — 15 —— 6
35. 433 0 0 — 25 —— 5
36. 654 0 0 — 30 —— 5
37. 565 0 0 — 18 —— 5
38. 76 13 4 — 27 —— 5
39. 67 16 8 — 33 —— 4
40. 63 2 6 — 37 —— 4
41. 75 18 4 — 39 —— 4
42. 161 6 8 — 40 —— 3
43. 253 8 9 — 40 —— 3
44. 358 10 8 — 43 —— 2½
45. 468 3 1½ — 46 —— 2½
46. 69 7 10½ — 47 —— 2½
47. 70 11 6 — 45 —— 3½
48. 78 9 4 — 48 —— 3½
49. 137 13 3 — 50 —— 3½
50. 140 5 8 — 50 —— 4

Per Cent.

51. £150 7 6 for 51 days at 4
52. 91 19 4 — 52 —— 4
53. 81 4 11 — 53 —— 4
54. 71 16 7 — 54 —— 4
55. 77 3 11 — 56 —— 1¼
56. 88 14 10 — 65 —— 1½
57. 87 5 9 — 52 —— 2¼
58. 99 16 8 — 62 —— 2¾
59. 97 7 7 — 49 —— 3
60. 98 18 6 — 59 —— 3½
61. 95 9 5 — 69 —— 3½
62. 325 10 2 —140 —— 2
63. 76 6 6 —143 —— 3
64. 431 15 4 —145 —— 4
65. 89 8 10 —168 —— 5
66. 563 17 1 —176 —— 6
67. 98 6 11 —187 —— 2
68. 635 19 7 —188 —— 3

Per Cent.
69. £57 7 2 for 210 days at 4
70. 735 18 9 —213 —— 5
71. 43 11 10 —215 —— 3
72. 573 14 3 —449 —— 1
73. 49 9 11 —209 —— 3
74. 857 12 8 —433 —— 3
75. 70 1 8 —231 —— 4
76. 785 16 5 —241 —— 3
77. 75 3 6 —257 —— 4
78. 648 2 3 —499 —— 5
79. 84 5 4 —189 —— 3

Per Cent.
80. £957 8 2 for 705 days at 4½
81. 88 7 1 —612 —— 3¾
82. 858 4 1½—201 —— 4⅓
83. 97 9 10 —575 —— 4½
84. 927 17 6 — 85 —— 7½
85. 457 16 0 — 95 —— 7⅓
86. 739 18 4 — 66 —— 2⅛
87. 956 13 4 — 76 —— 5⅛
88. 253 15 0 — 87 —— 4⅛
89. 458 17 6 — 89 —— 3⅛
90. 473 13 4 — 94 —— 5⅛

Find the interest on £720.

91. From 1st January to 24th February, at 2 per cent.
92. —— 24th January to 31st March, at 4 "
93. —— 15th March to 25th May, at 5 "
94. —— 1st May to 31st July, at 7 "
95. —— 29th June to 30th September, at 7½ "
96. —— 1st January to 31st May, at 2 "

On £673 5s.

97. —— 13th February to 17th May, at 2½ "
98. —— 11th February to 27th May, at 3 "
99. —— 3rd March to 13th July, at 3⅓ "
100. —— 17th June to 31st October, at 3¾ "
101. —— 27th June to 18th September, at 4 "
102. —— 21st May to 29th September, at 4½ "
103. —— 25th May to 31st August, at 5 "
104. —— 17th June to 17th October, at 5¾ "
105. —— 19th October to 31st December, at 7 "

On £96 18s.

106. —— 10th December to 1st Feby., at 7½ "
107. —— 11th January to 15th May, at 10 "
108. —— 19th January to 21st July, at 10 "
109. —— 1st April to 1st March, at 5⅛ "
110. —— 17th Apr. to 30th November, at 7⅛ "
111. —— 6th May to 1st December, at 8⅓ "
112. —— 21st February to 19th Aug., at 4 "
113. —— 11th September to 16th June, at 4½ "
114. —— 9th January to 1st October, at 5 "
115. —— 30th July to 23d April, at 5⅛ "
116. —— 30th July to 24th December, at 7⅛ "

Find the Interest on the following Accounts, at 4 per cent. without first calculating for each item; thus, taking the 117th account,

(1.) Multiply £291 by 32, and £917 by 23.
(2.) Add their results together.
(3.) Multiply their sum by 8, the double of the rate per cent.
(4.) Divide the last product by 73000.

117. On £291 0 0 for 32 days, and on £917 0 0 for 23 days.
118. £672 0 0 — 18 —— £765 0 0 — 81 —
119. £1207 0 0 — 21 —— £2108 0 0 — 35 —
120. £49 7 7½ — 33 —— £48 17 4¾ — 35 — and
£301 7 10 — 41 days.
121 £51 10 6 — 41 —— £55 11 7 — 45 — and
£58 13 5 — 47 days.
122. £230 9 1 — 47 —— £78 2 9 — 50 — and
£100 18 0 — 50 days.

Calculate the Interest on the following Section, as in the case of the 117th account, above.

123. £73 from Jan. 7 to April 17, and on £87 from April 17 to July 31, at 5 per cent.
124. £97 from Oct. 7 to Nov. 30, on £60 from Nov. 2 to Jan. 5, and on £360 for 35 days, at 4½ per cent.
125. £80 15s from Oct. 10 to Dec. 10, on £70 12s from Oct. 10 to Dec. 31, and on £450 for 23 days, at 4½ per cent.
126. £94 11s from Oct. 18 to Dec. 31, on £78 15s from Oct. 18 to Dec. 17, and on £69 for 50 days, at 5 per cent.
127. £71 19s from May 9 to July 21, on £20 14s from May 9 to Aug. 3, on £608 for 30 days, on £731 15s 6d from May 9 to July 20, and on £75 18s from May 9 to Dec. 12, at 4½ per cent.

Find the amount of

					Per Cent.					From
128.	£671	18	4	for 30 days,	at 4	134.	£93	8	8	Jan. 1 to July 31.*
129.	763	15	9	— 40 —	4½	135.	71	13	4	Feb. 25 to Aug. 1.
130.	937	19	9	— 50 —	8½	136.	76	4	3	Feb. 7 to Sep. 1.
131.	648	15	4	— 35 —	5⅜	137.	46	14	10	Mar. 11 to Sep. 11.
132.	649	13	3	— 45 —	7½	138.	65	5	8	Jan. 5 to July 5
133.	769	19	8	— 55 —	7¼	139.	70	15	6	April 5 to Oct. 10.

* When no rate is mentioned, 5 per cent. is understood.

To calculate the interest on a bill or debt when partial payments are made.

Write the principal, that is the bill or debt, at the date when due, and below it the first payment, which subtract from the principal, and in like manner subtract each successive payment, then calculate the interest (as in the case of the 117th acct. above,) on principal and the several successive balances.

Example.

A bill for £200 became due on 3d March, whereof £70 was paid on the 28th March, £70 on the 17th of April, and the balance, including interest on 15th May, what did the last payment amount to, reckoning interest at 3½ per cent.?

					Days.
March 3	Bill due, ...	£200	0	0	× 25 = 5000
" 28	Paid, ...	70	0	0	
	Balance, ...	130	0	0	× 20 = 2600
April 17	Paid, ...	70	0	0	
	Balance, ...	60	0	0	× 28 = 1680
May 15	Int. due, ...	0	17	9½	
					9280
Amount of last payment,		£60	17	9½	7

73,000)64960(0
20
)1299200
17/9¼

Exercises.

1. A bill for £270 fell due on the 17th April, whereof £100 was paid on 30th April, £100 on 1st May, and the balance and interest on 1st June, what was the amount of the last payment?

2. A person borrowed £250 on the first March, at 4 per cent., which he paid as follows—viz., on May 7th, £100; on June 28th, £50; on July 17th, £50; and on the 25th September, £50. Find the interest due on the debt.

3. Became indebted to the bank, on the 27th November, £750, £350 of which I paid on the 1st January, £200 on the first April, and £200 on the first July. How much interest, at 4½ per cent., was due?

To calculate the interest on cash accounts and accounts current.

A cash account, or an account current, is written on two pages, the left is marked Dr. and the right Cr. The Dr. side contains the sums paid by the person furnishing the account, and the Cr. side the sums which the person furnishing the account receives.

The following example will show how the interest is calculated on these accounts.

Dr. A. B. in Account Current with the Union Bank. *Cr.*

Jan. 5.	To Cash *drawn,*	£500	Jan. 17.	By Cash *lodged*	£170
Feb. 7.	" "	120	Feb. 25.	" "	350
Mar. 3.	" "	100	Mar. 15.	" "	700
" 27.	" "	470	Apr. 20.	" "	50
April 1.	" "	90	" 26.	" "	100

Find the balance, including interest, till 21st May, allowing the Bank 5 per cent., and A. B. 4 per cent.

Dates.		Sums.	Days.	5 P. C.	4 Per Cent.
Jan. 5.	To	500	×12	6000	
" 17.	By	170			
	Dr.	330	×21	6930	
Feb. 7.	To	120			
	Dr.	450	×18	8100	
" 25.	By	350			
	Dr.	100	× 6	600	
March 3.	To	100			
	Dr.	200	×12	2400	
" 15.	By	700			
	Cr.	500	×12		6000
" 27.	To	470			
	Cr.	30	× 5		150
April 1.	To	90			
	Dr.	60	×19	1140	
" 20.	By	50			
	Dr.	10	× 6	60	
" 26.	By	100			
	Cr.	90	×25		2250

Interest,..................	£2	10	9½		25230	8400
Balance of Principal,	90	0	0		6720	1680=⅕ off.
Due A. B...............	£87	9	2½	7300 |	18510	6720=4°/o

1. Find the interest on the following account with the Union Bank of Scotland, until 26th December, allowing the Bank 5 per cent., and A. B. 4 per cent. on their balance.

Dr. Mr A. B., in Acct. Curt. with the Union Bank. *Cr.*

Jan. 1.	To Balance	£700	Jan. 30.	By Cash	£550
Feb. 20.	" Cash	870	March 7.	" "	800
May 10.	" "	200	April 15.	" "	300
July 27.	" "	1000	June 3.	" "	450
Aug. 19.	" "	150	Sept. 1.	" "	400

2. Calculate the interest due on the following account, to 1st November:—

Dr. George Scott, in Acct. Curt. with Smith & Co. *Cr.*

Feb. 15.	To Goods,	£450	March 8.	By Cash,	£ 90
April 7.	" Cash,	170	May 20.	" Bill,	500
June 27.	" Goods,	390	July 7.	" Sugar,	300
Aug. 15.	" Ins.,	40	Sept. 8.	" Rum,	200
Sept. 19.	" Goods,	500	Oct. 5.	" Cash,	170

DISCOUNT.

Discount is the sum that ought to be allowed for receiving payment of money before it is due.

The *present value* of a sum due at a future period is such a sum, that, if put out at interest for the given time and at the given rate, would amount to the sum then due.

In discounting bills, bankers and merchants charge a sum equal to the interest of the whole bill for the time it has to run, together with the *three days of grace*. After the bill falls due, three days more are allowed in Great Britain and Ireland for payment, and these are called *days of grace*.

When a bill is made payable at so many months after date, calendar months are understood. Thus a bill drawn on the 31st of August, at 3 months, would, without including the days of grace, fall due on the 30th November, and *legally* on 3d December. If a bill fall *legally* due on Sunday, payment is made in Great Britain on the *Saturday*, in Ireland on the *Monday*.

The proceeds of a bill is the sum received for it from the bank.

To find the true discount and present value.

Rule.—As the amount of £100, at the given rate and for the given time, is to the interest of £100, so is the debt to the true discount; or, as the amount of £100 is to £100, so is the debt to its present value.

Find the present value and true discount upon the following bills. Also, find the usual or banker's discount.

				Drawn.	Discounted.
1.	£420	17	5	Jan. 11th, at 3 months.	April 3d, at 4 per cent.
2.	680	2	6	Mar. 3d, at 6 "	May 17th, at 5 "
3.	217	19	11	Aug. 7th, at 2 "	Aug. 12th, at 4 "

4. What ready money is equivalent to £460 17s 6d, payable 3 months hence, allowing interest at $3\frac{3}{4}$ per cent?

A FRACTION

Is one or more of the equal parts of one or of any whole number, as $\frac{1}{4}$ or $\frac{3}{5}$, or $\frac{7}{8}$, or $\frac{1}{3}$ of 3, which is equal to $\frac{3}{3}$, or $\frac{1}{9}$ of 7, which is equal to $\frac{7}{9}$.

NUMERATOR AND DENOMINATOR.

A fraction is expressed by two numbers, one of which is placed above, and the other below a line, drawn between them as above. The number below the line is intended to indicate the number of parts into which the unit or whole number is, or is supposed to be, divided, and is called the *denominator;* that which is placed above the line shows the number of parts intended to be expressed by the fraction, and is called the numerator.

TERMS.

The numerator and the denominator of the fraction, when spoken of together, are usually called the terms of the fraction.

VULGAR FRACTIONS.

All fractions, when both the terms are expressed, are called common or vulgar fractions, as $\frac{3}{4}$, $\frac{3}{10}$, $\frac{25}{75}$, or $\frac{25}{100}$.

A MIXED NUMBER

Is a whole number with a fraction annexed to it, as $5\frac{1}{2}$, 6·75.

A PROPER FRACTION

Is one in which the numerator is less than the denominator, as $\frac{2}{3}$ or $\frac{7}{11}$.

AN IMPROPER FRACTION.

Is one in which the numerator is not less than the denominator, as $\frac{5}{5}$, or $\frac{4}{4}$, or $\frac{7}{2}$, $\frac{3}{2}$, $\frac{19}{7}$, &c., &c.

The Principle of the Reduction of Fractions.

A fraction is multiplied by a number by multiplying the numerator by that number, and keeping the same denominator, or by dividing the denominator and keeping the same numerator: thus, $\frac{4}{8}$ multiplied by 2 is $\frac{8}{8}$. For the whole number in each of the fractions $\frac{4}{8}$ and $\frac{8}{8}$ is divided into 8 equal parts, and in the fraction $\frac{8}{8}$ we have twice as many of the parts as we have in the fraction $\frac{4}{8}$.

A fraction is divided by a number by multiplying its denominator by that number, and keeping the same numerator, or by dividing the numerator and keeping the same denominator: thus, $\frac{4}{8}$ divided by 2 is $\frac{4}{16}$. For the whole number being divided into twice as many equal parts in $\frac{4}{16}$ as it is in $\frac{4}{8}$, each of the parts in $\frac{4}{8}$ is twice as great as each of the parts in $\frac{4}{16}$.

The value of a fraction is not altered by multiplying or dividing both its terms by the same number. For if the numerator be multiplied by any number the fraction is multiplied by it, and if the denominator be multiplied by the same number, the fraction is divided by it. The value of a quantity is not altered by multiplying and dividing it by the same number.

For example take $\frac{4}{8}$. Both terms of $\frac{4}{8}$ multiplied by $2 = \frac{8}{16}$, and both terms divided by $2 = \frac{2}{4}$; now, $\frac{4}{8}$, $\frac{2}{4}$, and $\frac{8}{16}$, are all equal, because they each are evidently equal to $\frac{1}{2}$.

CASE I.

To reduce a fraction to its lowest terms or *simplest form*.

1st Division.—The greatest common measure is under twelve. (See page 38.)

1. $\frac{2}{4}$
2. $\frac{6}{12}$
3. $\frac{3}{9}$
4. $\frac{4}{12}$
5. $\frac{8}{12}$
6. $\frac{10}{15}$
7. $\frac{12}{18}$
8. $\frac{12}{16}$
9. $\frac{16}{18}$
10. $\frac{12}{27}$
11. $\frac{15}{45}$
12. $\frac{4}{136}$
13. $\frac{10}{90}$
14. $\frac{20}{110}$
15. $\frac{20}{22}$
16. $\frac{5}{30}$
17. $\frac{64}{72}$
18. $\frac{18}{27}$
19. $\frac{36}{81}$
20. $\frac{16}{28}$
21. $\frac{35}{77}$
22. $\frac{42}{54}$
23. $\frac{6}{9}$
24. $\frac{33}{55}$
25. $\frac{20}{28}$
26. $\frac{8}{32}$
27. $\frac{9}{30}$
28. $\frac{21}{28}$
29. $\frac{22}{33}$
30. $\frac{9}{18}$
31. $\frac{40}{52}$
32. $\frac{66}{112}$
33. $\frac{95}{160}$
34. $\frac{184}{384}$
35. $\frac{84}{203}$
36. $\frac{147}{259}$
37. $\frac{72}{186}$
38. $\frac{88}{164}$
39. $\frac{91}{301}$
40. $\frac{50}{94}$
41. $\frac{70}{265}$
42. $\frac{207}{531}$

2d Division.—The greatest common measure is above 12, and must be found by the ordinary process.—(See p. 38.)

43. $\frac{403}{767}$
44. $\frac{5325}{5822}$
45. $\frac{1295}{1591}$
46. $\frac{1763}{2279}$
47. $\frac{5475}{5986}$
48. $\frac{3780}{4374}$
49. $\frac{2525}{2825}$
50. $\frac{8250}{9141}$
51. $\frac{7979}{8927}$
52. $\frac{18500}{20498}$
53. $\frac{214369}{228722}$
54. $\frac{5795}{20069}$
55. $\frac{71289}{81969}$
56. $\frac{55986}{63714}$
57. $\frac{648}{1548}$

CASE II.—1st Division.

To reduce a mixed number to the form of a simple fraction.

Multiply the whole number by the denominator of the fraction, and add the numerator to the product for the new numerator, and keep the same denominator.

1. $3\frac{1}{2}$
2. $4\frac{2}{5}$
3. $5\frac{5}{6}$
4. $6\frac{2}{7}$
5. $7\frac{7}{9}$
6. $8\frac{3}{8}$
7. $15\frac{2}{3}$
8. $17\frac{3}{4}$
9. $18\frac{4}{5}$
10. $13\frac{5}{6}$
11. $19\frac{6}{7}$
12. $16\frac{7}{8}$
13. $43\frac{2}{5}$
14. $52\frac{3}{7}$
15. $61\frac{4}{9}$
16. $37\frac{5}{11}$
17. $49\frac{1}{3}$
18. $68\frac{1}{5}$
19. $24\frac{9}{10}$
20. $37\frac{18}{100}$
21. $46\frac{171}{1000}$
22. $78\frac{7}{100}$
23. $29\frac{3}{1000}$
24. $35\frac{15}{1000}$
25. $4235\frac{1}{24}$
26. $7561\frac{7}{34}$
27. $9785\frac{11}{29}$
28. $8971\frac{43}{63}$
29. $7867\frac{11}{456}$
30. $6873\frac{792}{927}$

2d Division.—To reduce an improper fraction to a whole or mixed number.

Divide the numerator by the denominator for the whole number, and if there be a remainder write it as the numerator of the fractional part of the mixed number.

31. $\frac{19}{2}$
32. $\frac{19}{3}$
33. $\frac{23}{4}$
34. $\frac{23}{5}$
35. $\frac{17}{3}$
36. $\frac{18}{4}$
37. $\frac{21}{8}$
38. $\frac{317}{7}$
39. $\frac{29}{6}$
40. $\frac{475}{11}$
41. $\frac{297}{6}$
42. $\frac{675}{11}$
43. $\frac{374}{8}$
44. $\frac{474}{3}$
45. $\frac{3712}{21}$
46. $\frac{1975}{6}$
47. $\frac{7319}{31}$
48. $\frac{2976}{43}$
49. $\frac{7170}{73}$
50. $\frac{6117}{85}$
51. $\frac{4729}{93}$
52. $\frac{987}{77}$
53. $\frac{23456}{791}$
54. $\frac{456}{67}$
55. $\frac{568}{79}$
56. $\frac{68795}{43}$
57. $\frac{729861}{817}$
58. $\frac{79391}{935}$
59. $\frac{7261}{37}$
60. $\frac{34591}{271}$
61. $\frac{68572}{397}$
62. $\frac{25865}{793}$
63. $\frac{987114}{989}$
64. $\frac{91713}{857}$
65. $\frac{61791}{987}$

CASE III.—1st Division.

To reduce fractions of different denominators, *prime to each other*, to others of equal value, having the same denominator.

Find the least common multiple of all the denominators for the new denominator; divide this new denominator by the denominator of one of the given fractions, and multiply the *terms* of the fraction to be reduced, by the quotient, and do the same with each of the other given fractions.

To find the L. C. M., see p. 40.

1. $\frac{3}{4}$ & $\frac{2}{5}$
2. $\frac{2}{3}$ & $\frac{1}{7}$
3. $\frac{7}{8}$ & $\frac{4}{5}$
4. $\frac{1}{9}$ & $\frac{3}{10}$
5. $\frac{1}{2}$ $\frac{2}{3}$ & $\frac{1}{5}$
6. $\frac{3}{4}$ $\frac{1}{9}$ & $\frac{1}{5}$
7. $\frac{1}{7}$ $\frac{3}{5}$ & $\frac{5}{6}$
8. $\frac{1}{2}$ $\frac{1}{5}$ & $\frac{1}{3}$
9. $\frac{1}{2}$ $\frac{1}{5}$ $\frac{1}{3}$ & $\frac{1}{7}$
10. $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ & $\frac{1}{7}$
11. $\frac{1}{6}$ $\frac{3}{7}$ $\frac{4}{11}$ & $\frac{1}{5}$
12. $\frac{8}{9}$ $\frac{9}{10}$ $\frac{10}{11}$ & $\frac{12}{13}$
13. $\frac{1}{2}$ $\frac{1}{17}$ $\frac{1}{29}$ $\frac{50}{53}$ & $\frac{1}{5}$
14. $\frac{1}{3}$ $\frac{31}{32}$ $\frac{100}{101}$ $\frac{1}{10}$ & $\frac{1}{7}$
15. $\frac{1}{4}$ $\frac{13}{19}$ $\frac{4}{15}$ $\frac{1}{7}$ & $\frac{1}{11}$
16. $\frac{1}{7}$ $\frac{1}{23}$ $\frac{17}{18}$ $\frac{1}{11}$ & $\frac{1}{5}$

2d Division.—To reduce fractions of different denominators, *not prime to each other*, to others of equal value, having the same denominator, proceed as in 1st Division.

1. $\frac{1}{8}$ & $\frac{1}{4}$
2. $\frac{1}{9}$ & $\frac{5}{6}$
3. $\frac{3}{4}$ & $\frac{1}{12}$
4. $\frac{5}{8}$ & $\frac{7}{12}$
5. $\frac{3}{4}$ & $\frac{5}{6}$
6. $\frac{11}{12}$ & $\frac{3}{16}$
7. $\frac{9}{10}$ & $\frac{11}{15}$
8. $\frac{7}{9}$ & $\frac{5}{36}$
9. $\frac{4}{15}$ & $\frac{7}{20}$
10. $\frac{11}{20}$ & $\frac{13}{30}$
11. $\frac{1}{2}$ $\frac{2}{3}$ $\frac{1}{4}$ & $\frac{1}{8}$
12. $\frac{1}{2}$ $\frac{3}{4}$ $\frac{5}{6}$ & $\frac{7}{8}$
13. $\frac{3}{4}$ $\frac{1}{12}$ $\frac{5}{6}$ & $\frac{2}{9}$
14. $\frac{5}{8}$ $\frac{1}{4}$ $\frac{7}{12}$ & $\frac{5}{6}$
15. $\frac{1}{4}$ $\frac{1}{6}$ $\frac{1}{8}$ & $\frac{1}{3}$
16. $\frac{7}{10}$ $\frac{11}{20}$ $\frac{4}{5}$ & $\frac{9}{10}$
17. $\frac{1}{3}$ $\frac{20}{21}$ $\frac{4}{7}$ & $\frac{4}{7}$
18. $\frac{1}{3}$ $\frac{17}{18}$ $\frac{1}{6}$ & $\frac{7}{9}$
19. $\frac{2}{15}$ $\frac{3}{10}$ $\frac{1}{3}$ & $\frac{1}{6}$
20. $\frac{1}{2}$ $\frac{19}{32}$ $\frac{3}{8}$ & $\frac{3}{24}$
21. $\frac{3}{5}$ $\frac{29}{30}$ $\frac{2}{3}$ & $\frac{14}{15}$
22. $\frac{2}{5}$ $\frac{7}{15}$ $\frac{9}{10}$ & $\frac{3}{4}$
23. $\frac{4}{7}$ $\frac{17}{30}$ $\frac{5}{6}$ & $\frac{4}{15}$
24. $\frac{1}{6}$ $\frac{1}{60}$ $\frac{1}{15}$ & $\frac{1}{20}$
25. $\frac{5}{6}$ $\frac{5}{8}$ $\frac{7}{10}$ & $\frac{1}{20}$
26. $\frac{5}{12}$ $\frac{1}{6}$ $\frac{5}{7}$ & $\frac{3}{4}$
27. $\frac{11}{12}$ $\frac{13}{14}$ $\frac{2}{3}$ & $\frac{2}{7}$
28. $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ & $\frac{1}{10}$
29. $\frac{7}{8}$ $\frac{2}{3}$ $\frac{5}{6}$ & $\frac{3}{4}$
30. $\frac{1}{5}$ $\frac{5}{7}$ $\frac{1}{2}$ & $\frac{7}{10}$

CASE IV.—To find the sum of several fractions.

Reduce the fractions to a common denominator, and write the sum of the numerators over the common denominator, for the answer. Before applying this rule, reduce improper fractions to whole or mixed numbers; and when the fractions are of different denominations, reduce them to the same denomination, and if compound, to simple.

Note.—As a general rule, express all fractions to their lowest terms, and improper ones as mixed numbers.

1. $\frac{1}{9}$ & $\frac{1}{7}$
2. $\frac{1}{4}$ & $\frac{1}{5}$
3. $\frac{3}{7}$ & $\frac{2}{3}$
4. $\frac{5}{6}$ & $\frac{6}{7}$
5. $\frac{6}{7}$ & $\frac{7}{8}$
6. $\frac{7}{8}$ & $\frac{8}{9}$
7. $\frac{3}{4}$ & $\frac{7}{12}$
8. $\frac{2}{3}$ & $\frac{4}{9}$
9. $\frac{5}{6}$ & $\frac{7}{8}$
10. $\frac{6}{15}$ & $\frac{9}{10}$
11. $\frac{3}{11}$ & $\frac{14}{33}$
12. $\frac{9}{16}$ & $\frac{19}{20}$
13. $\frac{1}{8}$ $\frac{7}{8}$ & $\frac{2}{3}$
14. $\frac{1}{4}$ $\frac{5}{6}$ & $\frac{7}{12}$
15. $\frac{1}{8}$ $\frac{1}{5}$ & $\frac{4}{7}$
16. $\frac{1}{6}$ $\frac{17}{18}$ & $\frac{7}{19}$
17. $\frac{1}{16}$ $\frac{19}{32}$ & $\frac{1}{8}$
18. $\frac{7}{15}$ $\frac{9}{10}$ & $\frac{1}{2}$
19. $\frac{11}{12}$ $\frac{7}{36}$ $\frac{10}{27}$ & $\frac{8}{9}$
20. $\frac{3}{14}$ $\frac{5}{24}$ $\frac{29}{36}$ & $\frac{23}{24}$
21. $\frac{3}{14}$ $\frac{5}{24}$ $\frac{29}{36}$ & $\frac{23}{28}$
22. $\frac{19}{20}$ $\frac{1}{15}$ $\frac{19}{30}$ & $\frac{49}{30}$
23. $\frac{17}{18}$ $\frac{29}{36}$ & $\frac{7}{8}$
24. $\frac{29}{38}$ $\frac{49}{90}$ & $\frac{1}{19}$

CASE V.—To find the difference of two fractions.

Reduce the fractions to a c. d., and place the difference of the numerators over the c. d. for the answer.

1. $\frac{1}{2}-\frac{1}{3}$
2. $\frac{1}{3}-\frac{1}{4}$
3. $\frac{1}{4}-\frac{1}{5}$
4. $\frac{1}{5}-\frac{1}{6}$
5. $\frac{6}{7}-\frac{5}{6}$
6. $\frac{5}{6}-\frac{4}{5}$
7. $\frac{4}{5}-\frac{3}{4}$
8. $\frac{11}{12}-\frac{9}{10}$
9. $\frac{2}{5}\sim\frac{3}{7}$
10. $\frac{6}{11}\sim\frac{7}{12}$
11. $\frac{5}{8}\sim\frac{2}{3}$
12. $\frac{11}{15}\sim\frac{13}{17}$
13. $\frac{13}{18}-\frac{7}{19}$
14. $\frac{17}{28}-\frac{8}{21}$
15. $\frac{1}{36}-\frac{1}{45}$
16. $\frac{6}{7}\sim\frac{31}{36}$
17. $\frac{27}{42}\sim\frac{11}{18}$
18. $\frac{41}{49}-\frac{41}{56}$
19. $\frac{31}{83}-\frac{31}{90}$
20. $\frac{14}{29}-\frac{14}{50}$

CASE VI.—To find the product of two or more fractions, &c.*
Multiply the numerators together for the new numerator, and the denominators together for the new denominator.

1. $\frac{1}{2}$ of $\frac{1}{3}$
2. $\frac{1}{3}$ of $\frac{1}{4}$
3. $\frac{1}{2}$ of $\frac{1}{5}$
4. $\frac{1}{2}$ of $\frac{2}{3}$
5. $\frac{1}{3}$ of $\frac{4}{5}$
6. $\frac{1}{4}$ of $\frac{5}{7}$
7. $\frac{1}{7}$ of $\frac{3}{4}$
8. $\frac{17}{24} \times \frac{3}{4}$
9. $\frac{19}{60} \times \frac{2}{3}$
10. $\frac{29}{91} \times \frac{11}{3}$
11. $\frac{36}{23} \times \frac{3}{19}$
12. $\frac{50}{101} \times \frac{9}{11}$
13. $\frac{17}{37} \times \frac{17}{37}$
14. $\frac{16}{23} \times \frac{14}{25}$
15. $\frac{1}{3} \times 2$
16. $\frac{1}{9}$ of 3
17. $\frac{3}{7} \times 4$
18. $5 \times \frac{7}{8}$
19. $\frac{16}{51}$ of 7
20. $10 \times \frac{17}{24}$
21. $\frac{3}{4}$ of 29
22. $\frac{1}{3}$ of $2\frac{1}{2}$
23. $\frac{1}{9}$ of $3\frac{1}{4}$
24. $4\frac{1}{3} \times \frac{7}{8}$
25. $5\frac{3}{7} \times \frac{3}{7}$ of $\frac{2}{5}$
26. $7\frac{2}{5} \times \frac{16}{51}$ of $\frac{2}{3}$
27. $34\frac{3}{100} \times \frac{14}{3}$
28. $57\frac{1}{100} \times \frac{4}{7}$ of $\frac{11}{13}$

CASE VII.—To find the quotient of two fractions, &c.†
Invert the divisor and proceed as in Multiplication.

1. $\frac{7}{8} \div \frac{3}{4}$
2. $\frac{1}{3} \div \frac{1}{2}$
3. $\frac{3}{4} \div \frac{2}{7}$
4. $\frac{1}{5} \div \frac{1}{4}$
5. $\frac{3}{4} \div \frac{2}{3}$
6. $\frac{43}{70} \div \frac{5}{6}$
7. $\frac{51}{17} \div 3$
8. $\frac{88}{65} \div 6$
9. $\frac{17}{99} \div 5$
10. $\frac{21}{13} \div 12$
11. $25 \div \frac{4}{7}$
12. $35 \div \frac{4}{9}$
13. $4\frac{1}{9} \div \frac{5}{6}$
14. $7\frac{3}{4} \div \frac{6}{7}$
15. $81\frac{2}{5} \div \frac{2}{3}$
16. $\frac{15}{16} \div 2\frac{1}{3}$
17. $\frac{16}{17} \div 4\frac{2}{5}$
18. $\frac{19}{18} \div 3\frac{7}{8}$
19. $\frac{1}{2}$ of $\frac{1}{2} \div \frac{1}{3}$ of $\frac{1}{3}$
20. $\frac{1}{3}$ of $\frac{3}{4} \div \frac{3}{7}$ of $\frac{3}{7}$
21. $\frac{8}{9}$ of $\frac{8}{9} \div \frac{1}{2}$ of $\frac{1}{4}$
22. $\frac{1}{4}$ of $2\frac{1}{2} \div \frac{1}{3}$ of $3\frac{1}{4}$
23. $3\frac{1}{2} \times 7\frac{2}{3} \div 4\frac{1}{2} \times 3\frac{1}{3}$
24. $2\frac{1}{2} \times 3\frac{2}{5} \div 5\frac{2}{5} \times \frac{3}{4}$

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* The multiplication of one fraction by another may be indicated either by placing the word *of*, or the *sign* of multiplication, between the two fractions: thus, the product of three-fourths by two-thirds is equally well indicated by either of the following expressions:— $\frac{3}{4} \times \frac{2}{3}$, or $\frac{3}{4}$ of $\frac{2}{3}$.

† The division of one fraction by another may be indicated in precisely the same manner as the division of one whole number by another—viz., by writing either sign of division between them, thus— $\frac{3}{4} \div \frac{2}{3}$, or thus, $\frac{\frac{3}{4}}{\frac{2}{3}}$ $\frac{2}{3}$ of $\frac{3}{4}$, and $\frac{\frac{3}{4}}{\frac{2}{3}}$, instead of being viewed, as above, as merely indicating the multiplication or division of one fraction by another, are sometimes used instead of the results of these operations. When so used the $\frac{2}{3}$ of $\frac{3}{4}$ is called a compound fraction, and the $\frac{\frac{3}{4}}{\frac{2}{3}}$ a complex fraction. $\frac{\frac{1}{2}}{4}$, $\frac{4}{\frac{1}{2}}$, $\frac{1\frac{1}{2}}{4}$, $\frac{4}{1\frac{1}{2}}$ $\frac{1\frac{1}{3}}{2\frac{5}{6}}$, are all, when used in this way, called complex fractions. $\frac{2}{3}$ or $\frac{3}{4}$, or $\frac{7}{8}$, *alone*, to distinguish them from such fractions, are called simple fractions; and the above processes, by which the $\frac{2}{3}$ of $\frac{3}{4}$ is converted into $\frac{1}{2}$, and the $\frac{\frac{3}{4}}{\frac{2}{3}}$ into $\frac{9}{8}$, are, in such cases, called *reducing* the compound or complex fraction to a simple one.

25. $\dfrac{\frac{7}{9}}{\frac{6}{5}}$ 28. $\dfrac{\frac{21}{17}}{9}$ 31. $\dfrac{5\frac{1}{2}}{\frac{6}{7}}$ 34. $\dfrac{\frac{3}{4}\text{ of }\frac{3}{4}}{\frac{3}{7}\text{ of }\frac{5}{6}}$

26. $\dfrac{\frac{15}{4}}{\frac{13}{7}}$ 29. $\dfrac{\frac{56}{11}}{8}$ 32. $\dfrac{\frac{21}{32}}{4\frac{1}{3}}$ 35. $\dfrac{\frac{3}{5}\text{ of }\frac{8}{9}}{\frac{2}{9}\text{ of }3\frac{1}{2}}$

27. $\dfrac{\frac{7}{8}}{\frac{2}{5}}$ 30. $\dfrac{\frac{61}{7}}{15}$ 33. $\dfrac{5\frac{1}{3}}{9}$ 36. $\dfrac{3\frac{1}{2}\times\frac{2}{9}}{\frac{3}{7}\text{ of }\frac{2}{3}}$

EXERCISES.

To find the value of a fraction.

Multiply the given integer by the numerator of the fraction, and divide the product by the denominator.

Examples.—What is the value of $\frac{5}{7}$ of a pound, and of £3 6s 8d?

7) £5 0 0

£0 14 $3\frac{1}{4}$ $\frac{5}{12}$=£$\frac{5}{7}$

£3 6 8
5
7 | 16 13 4
£2 7 $7\frac{1}{4}$ $\frac{5}{7}$

What is the value of—

(1) $1\frac{5}{8}$ of £1; (2) $\frac{5}{9}$ of a crown; (3) $\frac{5}{9}$ of a shilling; (4) $\frac{5}{9}$ of 6s 8d; (5) $\frac{2}{3}$ of a guinea; (6) $\frac{4}{5}$ of an acre; (7) $\frac{7}{13}$ of a cwt; (8) $\frac{9}{17}$ of a day; (9) $\frac{3}{5}$ of a yard; (10) $\frac{3}{7}$ of 21s; (11) $\frac{3}{7}$ of a lb. troy; (12) $\frac{12}{19}$ of a mile; (13) $\frac{1}{7}$ of 1 guinea + $\frac{1}{7}$ of £1+ $3\frac{2}{3}$ of 1 $\frac{1}{10}$ of $\frac{3}{5}$ of $5\frac{1}{2}$d; (14) $\frac{13}{15}$ of £3 7s 6d.

To find a sum of which another is a given fractional part.

Multiply the given sum by the denominator, and divide the product by the numerator.

Example—Of what sum is $4\frac{1}{2}$d three-fifths?

$4\frac{1}{2}$d
5
3)$22\frac{1}{2}$
$7\frac{1}{2}$d *Ans.*

PROOF.

$7\frac{1}{2}$d
3
5)$22\frac{1}{2}$
$4\frac{1}{2}$d *Ans.*

1. Of what sum is 2d two thirds? 2. Of what sum is 7d five-sixths? 3. Of what sum is 45s 6d seven-ninths?

To express a given quantity as a fraction of another given quantity.

Write the quantity to be reduced as the numerator of the fraction, and the integral quantity as the denominator, and then reduce both terms to one denomination for the required fraction.

Example.—Reduce 2s 4d to the fraction of £1.

$$\frac{2s\ 4d}{£1} = £\tfrac{28}{240} = £\tfrac{7}{60}$$

Here 2s 4d is reduced to pence for the numerator, and £1 to pence for the denominator.

Exercises.

1. Reduce 5d to the fraction of a shilling.
2. —— 3s 6d to the fraction of £1.
3. —— 8s 4d to the fraction of a guinea.
4. —— 2s 6d to the fraction of 6d.
5. —— 10s 4¼d to the fraction of £1.
6. —— 2 qrs 12 lb. to the fraction of 1 cwt.
7. —— 4 oz. 3 dwt. to the fraction of 1 lb. troy.
8. —— 3 roods 20 poles to the fraction of 3 acres.
9. —— £17 18s 6¼d to the fraction of 2½ guineas.
10. What fraction of a day is 5 hours 48′ 48″?
11. What fraction of a guinea is 7s 6d ?

To reduce a fraction from one denomination to another.

When the quantity is from a higher to a lower name, multiply the numerator by the number of the lower denomination, which makes 1 of the higher; and if from a lower to a higher name, multiply the denominator by it as in reduction of whole numbers, or express the quantity to be reduced as a fraction of the other quantity, and reduce this compound fraction to a simple one.

Example.—Reduce £$\frac{7}{9}$ to the fraction of a penny.

$$£\tfrac{7}{9} = \frac{7\times20\times12}{9} = \frac{1680}{9} = \frac{560}{3}$$

Or by rule 2d,

$$£1 = \frac{240}{1} \text{ of } 1d;\ \therefore £\tfrac{7}{9} = \tfrac{7}{9} \text{ of } \frac{240}{1} \text{ of } 1d = \frac{1680}{9} = \frac{560}{3}$$

Exercises.

1. Reduce £$\frac{7}{9}$ to the fraction of a farthing.
2. Reduce $\frac{7}{8}$ of 1 shilling to the fraction of £1.
3. Reduce $\frac{7}{9}$ of a farthing to the fraction of £1.
4. Reduce $\frac{2}{3}$ of a guinea to the fraction of £1.
5. What fraction of a pound is $\frac{5}{6}$ of a farthing ?
6. What fraction of a guinea is £$\frac{5}{8}$?
7. What fraction of an inch is $\frac{1}{3}$ of 6¼ yards?
8. What fraction of 17s 6d is $\frac{2}{3}$ of 1d ?
10. What fraction of £5 is 4½ of £1 5s 6d ?
11. Reduce $\frac{5}{7}$ of a scruple to the fraction of 1 lb.
12. Reduce $\frac{7}{25}$ of a ton to the fraction of 1 lb.
13. Reduce $\frac{6}{8}$ of a pole to the fraction of an acre.

DECIMALS.

DECIMAL NUMBERS.

The powers of 10, viz.—100, 1000, 10000, 100000, &c., are called decimal numbers.

DECIMAL FRACTIONS.

Fractions whose denominators are decimal numbers are called decimal fractions, or decimals, and are usually expressed without their denominators; thus—$5\frac{3}{10}$ is usually written 5·3; $24\frac{73}{100}=$ 24·73; and $51\frac{9}{1000}=51\cdot009$; the point being used to separate the numerator of the fraction from the whole number.

The value of each figure in a decimal decreases from the left to the right in a tenfold proportion; that is, the first figure to the right of the decimal point indicates 10th parts; the second figure, 100th parts; the next, 1000th parts, and so on. Adding ciphers to the right of a decimal does not alter its value; but adding to the left is equivalent to dividing by 10, 100, 1000, &c.

TERMINATE OR FINITE DECIMALS.

A *quantity* which *can be exactly* reduced to a decimal—as $\frac{1}{2}=\cdot5$, and $\frac{1}{4}=\cdot25$, &c.

INTERMINATE OR REPEATING DECIMAL.

A *quantity* which *cannot be exactly* reduced to a decimal—as $\frac{1}{9}=\cdot\dot{1}$, and $\frac{2}{9}=\cdot\dot{2}$, &c.

In reducing a vulgar fraction to a decimal, if *one* figure be repeated by the quotient continually, it is called a Single Repetend, and should it repeat more figures than one, it is called a Compound Repetend, or Circulating Decimal; and when the figures repeat from the point, it is called a Pure Repetend. If there be figures before those that repeat, it is called a Mixed Repetend, and the figures before those which repeat are called the *finite part* of the decimal.

REDUCTION.

To reduce a vulgar fraction to a decimal (1st), annex ciphers as decimals to the numerator (2d), divide the numerator, with the ciphers annexed, by the denominator; and if the figures in the quotient be equal in number to the ciphers annexed to the numerator, then place the decimal point to the left of them; and if they be less than the ciphers annexed to the numerator, make them equal by placing ciphers to the left of them, and place the decimal point to the left of the ciphers.

EXAMPLES.

Reduce $\frac{5}{8}$ to a decimal$=\cdot625$.

$$\begin{array}{r|l} 8 & \underline{5\cdot000} \\ & \cdot625 \end{array}$$

Reduce $\frac{7}{800}$ to a decimal$=\cdot00875$

$$\begin{array}{r|l} 800 & \underline{7\cdot00000} \\ & \cdot00875 \end{array}$$

Reduce the following fractions to decimals:—

1. $\frac{1}{2}$.	4. $\frac{11}{9}$.	7. $\frac{5}{6}$.	10. $\frac{7}{80}$.
2. $\frac{1}{4}$.	5. $\frac{5}{8}$.	8. $\frac{7}{27}$.	11. $\frac{49}{57}$.
3. $\frac{1}{3}$.	6. $\frac{16}{7}$.	9. $\frac{19}{13}$.	12. $\frac{635}{3049}$.

Any vulgar fraction, having 9 for its denominator, will produce the numerator as a single repetend; thus—$\frac{1}{9}=\cdot\dot{1}$; $\frac{2}{9}=\cdot\dot{2}$; $\frac{3}{9}=\cdot\dot{3}$; $\frac{4}{9}=\cdot\dot{4}$, &c.

To reduce a decimal to a vulgar fraction—Write the given decimal for the numerator, and write 1 for the denominator, with as many ciphers annexed as there are figures in the decimal. Reduce the fraction to its least terms. Examples—$\cdot 7=\frac{7}{10}$; $\cdot 07=\frac{7}{100}$; $\cdot 25=\frac{25}{100}$. When the decimal is a pure repetend, write for the denominator as many 9's as there are circulating figures, and when it is a mixed repetend, subtract the finite part from the whole decimal, considered as a whole number, for the numerator, and for the denominator write as many 9's as there are repeating figures, and as many ciphers as there are finite figures.

EXAMPLES.

Reduce ·325 to a vulgar fraction $\cdot 325=\frac{325}{1000}=\frac{13}{40}$.

Reduce $\cdot\dot{3}2\dot{4}$ to a vulgar fraction $\cdot\dot{3}2\dot{4}=\frac{324}{999}=\frac{12}{37}$.

Reduce $\cdot 43\dot{6}\dot{8}$ to a vulgar fraction $\cdot 43\dot{6}\dot{8}=\frac{4368-43}{9900}=\frac{4325}{9900}=\frac{173}{396}$.

EXERCISES.

Reduce to Vulgar Fractions.

(13.) ·7, ·70, ·07, $\cdot\dot{7}$, ·46, ·4600, and ·0046.

(14.) ·276, ·0276, ·00925, and ·8025.

(15.) $\cdot 8\frac{3}{4}$, $\cdot 084\frac{1}{2}$, $\cdot 684\frac{1}{8}$, and $\cdot 2136\frac{7}{8}$.

(16.) $\cdot\dot{8}$, $\cdot\dot{0}\dot{3}$, $\cdot\dot{6}\dot{3}$, $\cdot\dot{7}2\dot{9}$, $\cdot\dot{2}4\dot{8}$, and $\cdot\dot{6}2438\dot{4}$.

(17.) $\cdot 0\dot{3}\dot{8}$, $\cdot 00\dot{3}$, $\cdot 0\dot{3}2\dot{4}$, $\cdot 02\dot{4}6\dot{2}$, $5\cdot 321\dot{9}\dot{8}$.

ADDITION AND SUBTRACTION OF DECIMALS.

In setting down decimals to be added or subtracted, like denominations must be kept under each other, and added or subtracted as in whole numbers: thus—$\cdot 7+45\cdot 68+1\cdot 0375+\cdot\dot{6}+2\cdot\dot{5}6\dot{7}$.

$$\begin{array}{r@{}l} & \cdot 7 \\ 45 & \cdot 68 \\ 1 & \cdot 0375 \\ & \cdot 66666666 \\ 2 & \cdot 56756756 \\ \hline 50 & \cdot 65173\dot{4}1\dot{2} \end{array}$$

EXERCISES.

Add together

1. $75\cdot268+\cdot68472+\cdot076+\cdot0085+3\cdot0007$.
2. $7\cdot6076+314\cdot7+56\cdot0001+\cdot8+\cdot96732$.
3. $862\cdot\dot{7}\dot{3}+12+12\cdot8649+486\cdot\dot{3}75\dot{6}+\cdot8769$ and $76\cdot\dot{7}\dot{6}$.

Find the value of the following—

1. $376\cdot482-7\cdot863$; and $376\cdot482-7\cdot8$.
2. $673\cdot287-154\cdot1267$; and $3\cdot75-\cdot00967$.
3. $26\cdot285-\cdot\dot{6}84\dot{7}$; and $2\cdot60073-\cdot9050\dot{7}$.
4. $\cdot0002-\cdot0000876$; and $\cdot01-\cdot009\dot{8}7\dot{6}$.

MULTIPLICATION.

Multiply as in whole numbers, and point off from the product as many figures for decimals as there are decimal places in both multiplier and multiplicand; thus—$768\cdot956\times5\cdot076=$

$$\begin{array}{r} 768\cdot956 \\ 5\cdot076 \\ \hline 4613736 \\ 5382692 \\ 38447800 \\ \hline 3903\cdot220656 \end{array}$$

1. $36\cdot7\times36\cdot7$; and $6\cdot895\times27\cdot21$.
2. $\cdot005\times\cdot76$; and $\cdot0001\times\cdot007$.
3. $23\cdot77\times3\cdot01$; and $\cdot0073\times6000$.

When the multiplicand is a repetend, proceed as before, but to the product of the right-hand figure of each line take in the carriage that would have arisen had the repeating figure or figures been written twice; and before adding, extend to the right, to the same length, the repeating figures in each line. In multiplying a single repetend, carry 1 at 9. When the multiplier is a repetend, reduce it to a vulgar fraction, then multiply by the numerator, and divide the product by the denominator.

EXAMPLES.

Mult. $87\cdot2\dot{3}$ by $\cdot831$

$$\begin{array}{r} \cdot831 \\ \hline 872\dot{3} \\ 261700 \\ 6978666 \\ \hline 72\cdot49090 \end{array}$$

Mult. $234\cdot3\dot{6}8\dot{5}$ by $\cdot296$.

$$\begin{array}{r} \cdot296 \\ \hline 140621\dot{1}\dot{4} \\ 210931711 \\ 468737137 \\ \hline 69\cdot37310\dot{6}\dot{3} \end{array}$$

EXERCISES.

4. Mult. $346{\cdot}24\dot{6}$ by 36·7
5. Mult. $28{\cdot}67\dot{4}$ by 583
6. Mult. $2{\cdot}863\dot{4}\dot{5}$ by 1·346
7. Mult. $2{\cdot}6\dot{3}\dot{5}$ by ·0027
8. $6{\cdot}\dot{8}3476\dot{1}\times 328{\cdot}6$
9. $32{\cdot}\dot{2}6\dot{8}\times 6{\cdot}\dot{8}042\dot{3}$
10. $\cdot\dot{6}82\dot{3}\times\dot{4}832\dot{1}$
11. $853{\cdot}\dot{7}689\dot{0}\times 6{\cdot}3\dot{7}4\dot{0}$.

DIVISION.

Divide as in whole numbers, and for decimals point off from the quotient as many places as the decimal places in the dividend *exceed* those in the divisor. When the decimal places in the divisor exceed those in the dividend, before commencing to divide, annex ciphers to the dividend, so that the division may be carried on; and reckon those employed as so many decimal places. When the dividend is a repetend, bring down the repeating figures in their order to the remainder, instead of ciphers. When the divisor is a repetend, reduce it to a vulgar fraction, then multiply the dividend by the denominator, and divide the product by the numerator.

EXAMPLES.

Divide ·48633 by ·43.

·43)·48633(1·131
43
56
43
133
129
43
43

Divide ·2748 by 119

$119\,)\cdot 27\dot{4}\dot{8}(\ \cdot 00230965$
238
368
357
1148
1071
774
714
608
595
13 remainder.

$468{\cdot}721\div\dot{3}$.

$\dot{3}=\frac{3}{9}=\frac{1}{3}$

468·721
3
1406·163

EXERCISES.

1. 27·534 ÷ 2·6.
2. ·10754 ÷ ·54.
3. 5678·34 ÷ ·025.
4. 171·3 ÷ ·0037.
5 76·00845 ÷ 27·3.
6. ·09 ÷ ·01.
7. 4 ÷ ·006.
8. ·006 ÷ ·001.
9. ·000145 ÷ 8·457.
10. $\cdot\dot{2}\dot{7}\div\cdot 6452$.
11. $6{\cdot}\dot{4}85\dot{1}\div\cdot 0025$.
12. $43{\cdot}51\dot{4}760\div\cdot 23$.
13. $\cdot 6485\div\dot{2}3\dot{8}$.
14. $64{\cdot}\dot{6}3\dot{4}\div 926{\cdot}\dot{3}\dot{2}$.
15. $\cdot\dot{0}468\dot{3}\div\cdot 36\dot{8}2\dot{9}$.

DISTRIBUTIVE PROPORTION.

1. Divide £400 between A and B, according to their ages, A being 25, and B 20 years of age.

2. Divide 120 marbles amongst 4 boys, according to their ages. A is 15 years of age, B 10, C 8, and D 7.

3. The net gain of two individuals in partnership last half year amounted to £500. If this be divided between them, in proportion to their capital, how much will be due to each, A having advanced £600, and B £450?

4. A, B, and C, purchase a ship in 12 shares, of which A pays for 7, B for 3, and C for 2. The nett freight of the first voyage amounted to £395; how much of this is due to each?

5. A insures on a cargo from London to Riga £2700, B insures £2500, and C £1500. The goods in the course of the voyage are damaged to the extent of £2401 5s 11d; find how much of this loss each underwriter must sustain, the loss of each being in proportion to the sum he insured.

6. A lady bequeathed £2000 to her three servants, to be divided amongst them in proportion to the time which each had served her. Now, as A served 35 years, B 24 years and 5 months, and C 10 years and 9 months, find how much is due to each.

7. Limestone, the well-known substance from which the mason obtains lime for his mortar, is composed of 22 parts carbonic acid gas, and 28 parts lime; how much lime, therefore, might be obtained from 1000 tons of limestone?

8. Limestone *might be viewed* as composed of 24 parts oxygen 20 parts of the metal calcium, and 6 parts of carbon. Find how many grains of each of these elements are contained in 1000 grains of the limestone.

9. Plaster of Paris is composed of 40 parts sulphuric acid, and 28 parts lime; how much of each of these ingredients is in 748 tons of the plaster?

10. Plaster of Paris *may be viewed* as composed of 32 parts oxygen, 20 parts of the metal calcium, and 16 parts sulphur; how much of each in a piece of the plaster weighing 476 grains?

11. A vessel valued at £3000, on a voyage from Leith to Hamburg, is insured as under—A insures £400, B £500, C £750, and D £550, and the proprietors risk the rest. During the voyage, in a storm, it lost its anchor, and was otherwise damaged to the amount of £253 17s 11d; how much of this loss must be borne by the proprietors, and each of the underwriters?

12. Divide £200 amongst A, B, and C, in the proportion of ½ to A, ⅓ to B, and ¼ to C.

13. Divide £3000 amongst W, X, Y, and Z, in the proportion of ⅓ to W, ¼ to X, ⅕ to Y, and ⅙ to Z.

14. A father left £6000 (after expenses were deducted), to be divided amongst his 4 sons, in the proportion of a ⅓ to A, a ¼ to B, a ⅕ to C, and ⅙ to D. The trustees gave to A £2000 (the ⅓ of £6000), to B £1500 (the ¼ of £6000), to C £1200 (the ⅕ of £6000), and to D £1000 (the ⅙ of £6000). Find the amount of the fraud, and the extent to which the trustees defrauded each.

EQUATION OF PAYMENTS.

To find an average time at which two or more sums due at different times should be paid at once—Multiply each debt by the time it has to run, reckoning from the date of the first. Divide the sum of the products by the sum of the debts, as in the following

EXAMPLE.

At what time should £170, due 1st Jan.; £120, due 17th Feb.; and £200, due 20th March, be paid in one payment?

Jany. 1st, £170
Feby. 17th, 120 × 47 = 5640
March 20th, 200 × 78 = 15600

490) 21240 (43 days from Jan. 1., viz, Feb. 13.

EXERCISES.

1. A debt of £70 is payable in 40 days, another of £20 in 30 days, and £100 in 60 days; find the equated time to pay the whole at once.

2. Bought goods payable as follows—£25 on the 2d Feb; £50 on the 1st June; £100 on 7th July; £40 on 1st August; and £90 on 3d Sept. Find the time at which the whole ought to be discharged in one payment.

3. A debt was to be discharged thus—¼ in ready money; ⅓ at 3 months, ⅕ at 4 months, ⅛ at 6 months, and the balance at 8 months; find the time for paying the whole at once.

4. What is the equated time for discharging at one payment a debt, ⅕ of which is due at present, ⅓ in 4 months, ⅙ in 5 months, 1/10 in 6 months, ⅐ in 7 months, and the remainder in 8 months?

PROFIT AND LOSS.

The computations are generally performed by proportion as in the following examples:—

1. Bought sugar at 46s 8d per cwt. and sold it at 42s per cwt., what was my loss per cent.?

Prime cost. Loss on prime cost.
46s 8d : 4s 8d : : £100 : £10 per cent. loss.

2. Bought cloth at 5s 10d a yard, how must I sell it to gain 20 per cent.?

£100 : £120 : : 5s 10d : 7s a yard.

3. Bought cloth at 7s a yard, which, having received damage, I am willing to sell at a loss of 20 per cent., how much must I charge per yard?

£100 : £80 : : 7s : 5s $7\frac{1}{5}$d, selling price per yard.

4. (1.) By selling tobacco at 3s 8d per lb. cash, I gain 10 per cent., what was the prime cost per lb.?

£110 : £100 : : 3s 8d : 3s 4d prime cost per lb.

(2.) If by selling as above I had lost 10 per cent., what would have been the prime cost?

£90 : £100 : : 3s 8d : 4s $0\frac{3}{4}\,\frac{5}{9}$ prime cost per lb.

(3.) If by selling at 3s 8d per lb. cash, I gain 10 per cent., what would I gain per cent. were I to allow 6 months' credit?

£$102\frac{1}{2}$: £100 : : £110 : £$107\frac{1}{2}$
£$107\frac{1}{2}$ — £100 = £$7\frac{1}{2}$ per cent.

5. Bought sugar at 38s per cwt., at what must I sell it to clear 10 per cent. and allow 4 months' credit?

£100 : £110 : : 38s : $\frac{11 \times 61 \times 38}{10 \times 60} = 42\text{s } 1\frac{3}{4}\,\frac{21}{25}\text{d.}$
100 : $101\frac{2}{3}$

6. Sold tea at 4s 4d per lb., and gained 5 per cent., what would I gain per cent. were I to sell the remainder at 4s 8d per lb.?

4s 4d : 4s 8d : : £105 : £113 1 $6\frac{1}{4}\,\frac{1}{13}$
£113 1 $6\frac{1}{4}\,\frac{1}{13}$ — £100 = £13 1 $6\frac{1}{4}\,\frac{1}{13}$ per cent.

Exercises.

1. If I sell tea which cost 4s 8d per lb. for 5s per lb., what is my gain per cent.?
2. How must cheese, which cost £3 7s 6d per cwt., be sold to gain 20 per cent.?
3. By selling sugar at 70s per cwt. I lost $7\frac{1}{2}$ per cent., what was the prime cost?
4. Bought 1 cwt. of sugar at 80s, and retailed it at 7d per lb., what did I gain or lose per cent.?
5. If, by selling cheese at £3 10s per cwt., I gain $5\frac{1}{2}$ per cent., what will be the gain per cent. by selling at 9d per lb.?
6. By selling 220 yards of cloth for £93 10s, I gain 15 per cent., at what price per yard must I sell that I may gain 20 per cent.?
7. Bought at 2s 10d, and sold at 3s 4d, allowing 6 months' credit, what was the gain per cent.?

8. Paid 3s 2½d a yard for linen, and sold it at a profit of 20 per cent., at what did I sell it per yard?

9. If I mix teas in the following proportions, viz., 2 lbs. at 3s 4d 3 lbs. at 4s, and 5 lbs. at 4s 8d, what will I gain or lose per cent. by selling the mixture at 5s per lb.?

10. When I sell eggs at 3 a penny, I gain 2½ per cent., what would I gain or lose per cent. were I to sell them at 23 for 6d?

11. A ship, worth £3000, is insured to the extent of 90½ per cent. of its value, what would the owner of $\frac{2}{7}$ of her lose were the ship lost?

12. By selling flour at 40s a sack, I sustained a loss of 5 per cent., what would have been my gain or loss per cent. had it been sold at 44s per sack?

13. At what price per yard must I sell cotton to get 7d a yard, after allowing a discount of 10 per cent?

14. Bought cloth at 2s 6d per yard, at what price must I sell it per yard to clear 20 per cent. profit, after allowing a discount of 5 per cent.?

95 : 120 : : 2s 6d : 3s 1¾ $\frac{11}{19}$.

15. Bought flour at 25s 6d per barrel, how must I sell it per barre to have 10 per cent. profit, after allowing a discount of 2½ per cent. and 6 months' credit?

MARINE INSURANCES.

Insurance is a contract by which one party engages, in consideration of a stipulated per centage, called premium, to make good to another party, in case of loss or damage, goods which are exposed to risk.

The stamped material, (paper or parchment) on which this contract is written, is called the "Policy," and the price of the stamp "Policy duty."

Insurers are the parties who write their names at the bottom of the policy, with the sums for which they engage, and are therefore called underwriters.

Policy duty is charged on any part of £100 as though it were a *whole* hundred, that is, £120 would be charged the same duty as £200, and £270 as £300.

1. Find the expense of insuring, from Glasgow to Adelaide, £670, at 30s per cent., policy duty 2s 6d per cent., and brokerage ½ per cent.

2. An insurance was effected on £3056, from Leith to Hamburgh, at 3½ guineas per cent., policy duty 5s per cent., and commission ½ per cent. Find the cost.

3. Find the expense of insuring £1576 on a cargo from Liverpool to New York, at 1½ guinea per cent., policy 2s 6d per cent., and brokerage ½ per cent.

4. How much must be insured to *cover* £300, premium 4½ guineas per cent., policy 2s 6d, and commission ½ per cent.?

Premium, ... £4 14 6
Policy and commission, 0 12 6

£5 7 0 sum to be paid to recover £100 in case of total loss; so, in reality, £94 13s is the net sum recovered ∴ we must say, as £94 13s is to £100, so is the sum to be covered at the above rates to the sum to be insured.

5. What sum must be insured to cover £575, premium 4¼ guineas per cent., policy 5s, and commission ½ per cent.?

Computations of Averages are made by Distributive Proportion, thus, as the whole value of goods, of which part is lost or damaged, is to the whole loss, so is each person's share to his proportional average loss. When a ship is overtaken by a storm, it is sometimes necessary to make deliberate sacrifices to prevent shipwreck, such as cutting away masts, rigging, or cables, or throwing part of the cargo overboard. As these sacrifices, and other expenses, are made for the general benefit of all interested in the vessel, freight, and cargo, the owners must sustain these losses in proportion to their interest in the ship, freight, or cargo, and this is called "General Average."

When a *total loss of part* of goods ensured has taken place in consequence of the accidents of the sea, it is called "Partial Loss."

Particular Average is a partial loss of the ship or cargo, or damages sustained by the common accidents of the sea, and is borne or paid by the owners or insurers of the particular articles damaged.

Goods thrown overboard are valued at the price they would have brought had they arrived in good order, but masts, rigging, &c., cut away, are valued at one third less than the cost of replacing them, as the new ones are considered better to that extent.

When goods valued in the policy receive damage, the underwriters are bound to pay the owners such proportion of the value as corresponds with the diminution in their value caused by such damage. Thus, if the value in the policy were £80, and if the damaged goods sell for £100, whereas, had they not been damaged, they would have brought £120, the difference in value between the damaged and sound is one sixth, consequently the underwriters pay one sixth of £80, the price named in the policy. But had the goods been sold in a losing market, when damaged, for £50, whereas, had they been sound, they would have brought £100, the difference between the sound and unsound is one half, and, consequently, the underwriters would have to pay one half of £80, the value stated in the policy.

EXAMPLE.

6. A ship, on a voyage from Grenada to London, was overtaken by a storm, and sustained the following losses:—Masts, cables, and rigging cut away, the expense of replacing which was £660; an anchor was lost, which cost £50; of 50 hhd. of sugar, 20 were thrown overboard, valued at £30 per hhd., and the remaining 30 hhds. were so damaged that it was necessary to sell them on arrival. They were sold for £20 per hhd., whereas, had they been sound, they would have brought £24 per hhd. The charges for pilotage, &c., amounted to £50. The value of the ship was £6000; the net proceeds of the cargo, per account sales, £9000; the gross freight, £1900, from which deduct £120 for seamen's wages. The ship was insured to half her value, and £5900 insured on account of the cargo. Find the general and particular average loss per cent., and how much each party had to pay?

Cost of replacing masts, cables, &c., ...	£660	
Deduct one third for newness, ...	220	
		£440
Anchor lost, which cost		50
20 hhds. of sugar thrown overboard, value		600
Charges for pilotage, ...		50
Total general average loss, ...		£1140

Value of the ship, ...		£6000
" cargo, ...		9000
Gross freight, ...	£1900	
Deduct for seamen's wages, ...	120	
		1780
Value of ship cargo, and freight, ...		£16780

£16780 : £1140 : : £100 : £6 15s 11d general average lossper cent.

£24 — £20 = £4 loss on each hhd.

£24 : £4 : : £100 : £16 13s 4d particular average loss per cent.

£900 at £16 13s 4d per cent. = £150.

9000 : 150 : : £5900 : 98 6 8 underwriters' share of par. average.

9000 : 150 : : £3100 : 51 13 4 owners' share of particular average.

£150 0 0

On account of General Average—

The underwriters pay for ship £6 15s 11d per cent. on		£3000 =	£203	17	6
The underwiters pay for cargo	do.	5900 =	400	19	1
Owners of cargo pay	do.	3100 =	210	13	5
Owners of ship pay	do.	4780 =	324	16	10
			£1140	16	10

NOTE.—This is one of the cases in which the amount paid exceeds that claimed.

Each party has to pay as under—

	£	s	d		£	s	d
Owners of ship pay for general average, ...					£324	16	10
Owners of cargo pay for general average,	£210	13	5				
and for particular average, ...	51	13	4	=	262	6	9
Underwriter's pay for general average,	604	16	7				
and for particular average, ...	98	6	8	=	703	3	3

EXERCISES.

7. A general average of £25 7s 5d per cent. is claimed upon a loss of £870; find the net proceeds, allowing ½ per cent. for brokerage, and 2½ per cent. for commission.

8. The ship, *Mary*, on a voyage from Hong-Kong to London, having met with bad weather, was obliged, for the preservation of the ship and cargo, to cut away her masts, cables, and rigging, the cost of replacing which was £414 7s 10d. She lost an anchor worth £60, and goods valued at £1400 were thrown overboard; she was taken into port to have damages repaired, the expense of which, together with unloading and reloading, was £275, pilotage, £50, and the seamen were allowed a gratuity of £80. The ship was valued at £13000, the net freight £1750, and the cargo £10500. The ship and freight were insured to ⅜ of their value, and £6500 of the cargo was insured. Find the general average loss per cent., and how much each party had to pay.

9. Insurance was effected on 18 cases of cotton goods, on board the *Mary*, Captain Smith, from Leith to Gibraltar, valued in the policy at £1635, but were invoiced, independent of charges, at £1545. In the course of the voyage, the sea water got in, and when the ship arrived at Gibraltar it was found that one of the cases, valued in the invoice at £97 15s 6d, was damaged, so that it brought only 390 dollars, whereas, had it arrived sound, it would have brought 520 dollars. The expenses resulting from this loss amounted to £10 7s 6d. Find the amount of particular average, and the rate per cent.

£1545 : £1635 : : £97 15s 6d : £103 9s 5d, insured value.
520 — 390 = 130 dollars lost by damage.

D. 520 : D. 130 : : £103 9s 5d : £25 17 4
Expenses, ... 10 7 6

Amount of particular average, £36 4 10

£1635 : £36 4s 10d : : £100 : £2 4s 4d per cent.

10. A ship on a voyage from Cuba to Cork, having encountered a storm, sustained the following losses—masts, cables, and rig-

ging cut away, the expense of replacing which was £380, an anchor lost, which cost £50, 6 puncheons of rum, valued at £180, were thrown overboard, and 2 boats, valued at £25 each, were washed away; of 300 hhds. of sugar, valued in the policy at £30 per hhd., 200 were so damaged by the sea-water that they were sold for £12 15s each. The value of the ship was £4500, and the freight £800, ¾ths of which was insured, and the rest risked; the cargo was valued at £8000 and of which £6500 was insured. Find the general and particular average loss per cent.

THE BUYING AND SELLING OF STOCK.

Government Stock is the name given to the money lent to our Government, and the revenue from which the interest is paid is called "the Funds," although the term is now generally used to denote the loans themselves. As loans for the public service were contracted at different times, different rates of interest were allowed, according to the then existing circumstances, and these rates distinguish the different Stocks or Funds, some of which bear interest at 3, some at 3½, and some at 4 per cent., hence 3 per cents., 4 per cents., &c. The holder of stock has the power to sell it, and all sales or purchases are made through the medium of stockbrokers, who charge ⅛ or 2s 6d per cent. for their trouble, consequently the brokerage must be added to the cost of stock purchased, and deducted from that which is sold.

CASE I.

To find the Value of any Quantity of Stock.

RULE.—As £100 of stock is to the quantity of stock to be bought or sold, so is the *price* of £100 stock to the price of the quantity to be bought or sold.

Example—Bought £425 in the 3 per cents., at 98⅜ per cent., what have I to pay, allowing ⅛ for brokerage?

$$\pounds 100 : \pounds 425 :: \pounds 98\tfrac{1}{2}$$

$$\frac{\pounds 425 \times 98\tfrac{1}{2}}{100} = \pounds 418 \ 12s\ 6d.$$

Find the value of

1. £600 in the 3½ per cents., bought at 86⅜ per cent.
2. £876 —— 4 —— sold — 90¼ ——
3. £765 —— 3 —— sold — 66 ——
4. £430 Bank Stock, bought at 220½ per cent.
5. What did I gain by purchasing £500 in the 3½ per cents. at 79⅜ per cent., and selling at 80¼ per cent?

To find how much stock may be purchased for a given sum.

Rule.—As the price of £100 + the brokerage is to the purchase money, so is £100 to the quantity of stock.

Example.—How much stock, at 67⅝, will £1666 purchase?

67¾ : 1666 : : 100 : £2459 0 9½ $\frac{262}{271}$

Exercises.

1. How much stock, at 92¼, can be bought for £500?
2. —— —— 78⅛, —— —— £837?
3. —— —— 103⅝, —— —— £4738?
4. —— —— 98⅞, —— —— £3273?
5. —— —— 230, —— —— £7689?

To find the rate of interest which any given stock will yield.

Rule.—As the price of the stock + the brokerage is to £100, so is the dividend on £100 to the rate of interest.

Example.—What rate of interest is obtained by purchasing 3½ per cents. at 98⅜ per cent.?

98½ : 100 : : 3½ : £3 11 0¾ $\frac{23}{197}$

Exercises.

1. What rate of interest arises from investing in the 3 per cent. consolidated funds when at 76⅝?

2. If I were to purchase in the 8 per cents. at 99¾ what rate of interest should I obtain?

3. If the price of the 3 per cent. consols was 99¾ on 20th Nov., what rate of interest would arise from purchasing on that day?

Note.—The half-yearly dividends on the 3 per cent. consols, on the new 3½ &c., per cents., are payable on 5th Jan. and 5th July, and the 3 per cent. reduced annuities and 4 per cent. consols on 5th April and 10th October. The holder of stock, on the day of payment, receives payment for the preceding half-year. When stock is purchased between terms, the given rate must be diminished by the interest of £100 of stock for the time which has passed since the last term on which the dividends were paid to the time of transfer.

184 days : 138 days : : £1½ : £1⅛.
99¾ — 1⅛ = 98⅝ : 100 : : £3 : £3 0 10$\frac{0}{4}$ $\frac{40}{263}$

4. What rate of interest arises from money vested in the 4 per cent. consols on 5th Feb., when the price is 95⅛?

5. How much money must I invest in the 3½ per cents., at 83½, to produce £100 a year?

FOREIGN EXCHANGE.

Exchange is the paying or the receiving of money in one country for its equivalent in the money of another country, and the method of finding out how much of the money of one country is equal to a given sum of the money of another is done by proportion.

The *par of exchange* between two countries is the intrinsic value of the money of one country compared with that of another, and is estimated by the weight and purity of their coins. The true par should be computed by putting the gold coin of the one country against the gold coin of another, and the silver against silver.

The *course of exchange* is the sum of money of one country which is given as the value of a fixed sum of the money of another country, at some particular time, and which is seldom the same as the *par* or *real value*, but is sometimes more, and sometimes less, according to the circumstances of trade or the demand for bills.

TABLES OF FOREIGN MONIES IN WHICH ACCOUNTS ARE KEPT.

HOLLAND AND BELGIUM.—The rate of exchange with London is expressed in florins or guilders, and stivers, and also in schillings and grotes Flemish.

Exchange with London at par, 12 florins per £.sterling.
100 cents = 20 stivers = 1 florin or guilder = 20d. sterling.
16 pfenings=1 stiver=2 grotes=5 cents; 100 grotes=1 rixdollar.

Flemish Money.

12 grotes or pence=1 schilling; 20 schillings=1 pound=6 florins

NOTE.—*Banco* is the money placed in banks of deposit, and transferred in payment from one person to another, and is superior to *currency*. The difference between banco and currency is called *agio*, and it varies here from 2 to 5 per cent.

1. Reduce 4628 florins banco into currency, agio 4 per cent.
2. Reduce 8640 florins 16 stivers banco into currency, agio 3½ per cent.
3. Reduce 468 florins 14 stivers currency to banco, agio 2¾ per cent.
4. Reduce £500 sterling into florins, at the rate of 12 florins 40 cents per £.
5. Reduce £655 11s sterling into Dutch money, at the rate of 12 florins 25 cents per £.sterling.
6. Reduce £300 1s 8d sterling to Flemish currency, at the rate of 36s 8d Flemish banco per £.sterling, agio 4 per cent.

HAMBURGH.—Accounts are kept here in marks, schillings, and pfenings, and, in transacting exchanges, Flemish money is also used.

The agio varies from 20 to 25 per cent.

Exchange with London at par 13 marks banco 10½ schillings per £.

Hamburgh Banco and Currency.

12 pfenings (or 2 grotes Flem.) = 1 schilling.
16 schillings = 1 mark.
2 marks = 1 dollar.
3 marks = 1 rixdollar.
1 schilling Flem. banco = 6s Hamburgh banco.

1. Reduce £362 15s sterling to Hamburgh currency, agio 20 per cent., and exchange at 13 marks 12 sch. banco per £. sterling.
2. Reduce £420 17s 6d sterling to Hamburgh banco, at the rate of 13 marks 12 schillings banco per £. sterling.
3. Reduce 4727 marks 5 sch. Hamburgh to sterling money, exchange at 36s 2d Flemish per £. sterling.
4. Reduce 4000 marks 7 sch. Hamburgh currency to British money, exchange at 34s 10d Flemish per £. sterling, and agio 20 per cent.
5. Reduce 2428 marks 2 schillings Hamburgh currency to French money, exchange 3 francs for 25s Hamburgh banco, agio on the Hamburgh bank 25 per cent.

France.—Accounts here are kept in francs and centimes.
Exchange with London at par 25 francs 22 cents. per £.
5 centimes (1 sou) = ½d nearly.
10 centimes = 1 decime = 1d nearly.
10 decimes or 100 centimes = 1 franc = 9½d nearly.
Formerly the franc and livre were of the same value, but now
80 francs = 81 livres.

1. How much sterling money in 4864 francs 75 cents., exchange 25 francs 50 cents. per £. sterling?
2. Reduce £210 to francs, exchange 25 francs 15 cents. per £. sterling.
3. Reduce £418 17s 6d to French money, exchange 25 francs 20 centimes per £. sterling.

Spain.—Money here is of two kinds, called plate and vellon, the former being more valuable than the latter, in the ratio of 32 to 17.

Bills of exchange are negotiated with Britain in plate money only.

Vellon.
34 maravedis=1 real.
20 reals=1 piastre or Spanish hard dollar.

Plate.
34 maravedis=1 real.
8 reals=1 piastre.
4 piastres=1 pistole of exchange.

375 maravedis=1 ducat of exchange.

The piastre or dollar of plate is worth 3s 1¾d sterling; the Spanish hard dollar about 4s 2d; the real vellon about 2½d sterling, and the real of plate 4¾d sterling.

Exchange at par with London, 6 dollars, plate, 2¾ reals per £.

1. Reduce £433 14s 3d into reals vellon, exchange 36¼d per piastre.

2. Reduce £375 to piastres, at 37d per peso.

3. Reduce 2864 reals old plate into sterling, exchange 34d per piastre.

4. Reduce 2659 piastres 2 reals 29 maravedis to sterling, at 3s 2¾d per peso.

5. Reduce 7860 francs to reals vellon, exchange 16 livres 7 sous per pistole of exchange.

6. Reduce 730 francs to piastres, exchange 4 francs 15 centimes per peso.

Portugal.—Accounts are kept here in milreis and reis. Three kinds of money are used, viz.—legal money, that is ½ in paper, and ½ in specie. *Paper money* is at a discount of about 24 per cent. Specie is called *effective money*.

Exchange at par with London, 4s 10¼d per milrei.

1000 reis=1 milrei, 400 reis=1 crusado.

1. Reduce £641 1s sterling into milreis, exchange 4s 5d per milrei.

2. Reduce 2030 milreis 225 reis to sterling, exchange 4s 2d per milrei.

3. Reduce 8947 florins 18 stivers to Portuguese money, exchange 39¾ grotes per crusado of exchange.

4. Reduce 180 milreis 170 reis *paper money* to *effective money*, discount 24 per cent.

Leghorn.—Here exchanges are computed in piastres or pezzi, soldi, and denari, and in lire and centisimi.

12 denari di pezza=1 soldo di pezza; 20 soldi di pezza=1 pezza or dollar.

There are two kinds of lire—one called *long money* and the other *effective money*.—12 denari di lira=1 soldo di lira; 20 soldi di lira =1 lira; 1 lira=100 centisimi; 6 lire, long money=1 pezza or dollar=5¾ lire of effective money; 5¾ lire=3s 9⅛d sterling.

Exchange at par with London, 30 lire 69 centisimi per £.

1. Reduce £873 15s 7d sterling into pezza, exchange 45⅛d per pezza.

2. Reduce 4643 lire 17 soldi 6 denari, effective money, into sterling money, exchange 3s 11d per pezza.

3. Reduce 628 milreis 80 reis to Leghorn money, exchange, 960 reis per pezza.

Constantinople.—3 aspers=1 para; 40 paras=1 piastre=formerly, 98 piastres were nearly=£1, but now the exchange runs from 170 to 180 piastres to the £.; 500 piastres=1 purse; 30,000 piastres=a bag of gold.

Frankfort-on-the-Maine.—4 Kreutzers=1 batzen; 15 batzen=1 florin; 1½ florins=1 rixdollar (worth 36½d sterling).

The par of exchange with London is 148½ batzen per £.

Prussia.—12 pfenings=1 silver groschen; 30 silver groschen =1 Prussian dollar (worth 2s 10¾d sterling).

Par with London, 6 dollars 27 silver groschen per £.

Russia.—100 copecks=1 silver rouble (worth 3s 1½d sterling) the paper rouble (also divided into 100 copecks) is worth about 10¾d sterling.

Denmark.—12 pfenings=1 skilling; 12 skillings=1 mark; 8 marks=1 rigsbank dollar=1½ marks banco of Hamburgh.
The rigsbank dollar is=26·35d sterling, and the par of exchange with London is 9 rigsbank dollars 10 skillings per £ stg.

Sweeden.—12 rundstyken=1 skilling; 48 skillings=1 rixdollar; 1 silver rixdollar=4s 4½d, and 1 paper rixdollar banco=1s 8d sterling.

United States.—100 cents = 1 dollar = at par 4s 6d sterling, but the real value is about 4s 1½d. £100 sterling are = £109 11s 6d, U. S. currency, reckoning 4s 6d to the dollar.

In **Canada**, £100 currency are = £90 sterling. In **Jamaica**, £140 currency are = £100 sterling.

East Indies.—12 pice=1 anna, 16 annas=1 sicca rupee (worth about 2s). A lac of rupees is = 100,000 rupees, and a crore is = 100 lacs = 10 millions of rupees.

ARBITRATION OF EXCHANGE.

Arbitration of Exchange is the ascertaining, by a comparison of the exchanges of different places, the best mode of transmitting a sum of money through several places, so that, at the last place, it shall be of most value; in other words, how a sum of money may be increased by a circuitous remittance. As a general rule, draw upon the place where the course of exchange is below the arbitrated price, and remit to that where it is above it. The calculations may be performed by several statements in proportion, or by the following rule:—

Chain Rule.

Write the given rates of exchange in pairs, and place them in two columns, with this sign = between them, and let the principal term of which the value is sought be the first on the right hand. Write the equivalent pairs below, placing on the left, one step lower, the term which is of the same kind and in the same name as the one preceding it on the right. Divide the continued product of the right hand numbers by the continued product of the left, and the quotient will be the answer in the same name with the last term on the right hand.

EXAMPLES.

(1.) If a merchant in London owes a merchant of Paris £500, whether is it better for the London merchant to remit directly at 25 francs 40 cents. per £. sterling, or by a circuitous remittance through Hamburgh—the exchange of London on Hamburgh being 13 marks 11 sch. banco per £. sterling; that of Hamburgh on Paris, 188 francs per 100 marks, an expense of 1 per cent. being incurred by the circuitous course?

£500 sterling.
£1 sterling=$13\frac{11}{16}$ marks
100 marks=188 francs
100 99

$$\frac{500\times13\frac{11}{16}\times188\times99}{100\times100}=$$

	Francs.	Cents.	
	12737	$58\frac{3}{4}$	by the circuitous course.
	12700	0	by the direct course.
London merchant gains	37	$58\frac{3}{4}$	by the circuitous course.

(2.) A merchant in Amsterdam has to remit 600 florins to London, whether will it be cheaper for him to do so directly, the exchange being 11 florins 1 stiver per £.sterling, or through the following places; and what will be the difference per cent., the exchanges being—Amsterdam on Paris, 1 florin 8 stivers for 3 francs; Paris on Venice, 5 francs for 1 ducat; Venice on Hamburgh, 1 ducat for 50 stivers; Hamburgh on Lisbon, 25 stivers per crusado; and Lisbon on London, 5s 4d sterling per milree?

=600 florins=12,000 stivers.
28 stivers ... ... = ... 3 francs
5 francs ... ... = ... 1 ducat
1 ducat ... ... = ... 50 stivers
25 stivers ... ... = 1 crusado = 400 reis
1000 rees ... ... = ... 64d sterling.

$$\frac{\overset{3}{\cancel{12000}}\times3\times\overset{2}{\cancel{50}}\times\overset{80}{\cancel{400}}\times64}{\underset{7}{\cancel{28}}\times\cancel{5}\times\cancel{25}\times\cancel{1000}}=\frac{3\times3\times2\times80\times64}{7}=£54\ 17\ 1\tfrac{5}{7}\text{ cir. course.}$$

Stivers. Stivers.
28 : 12000 : : £1 : 54 5 $11\frac{1}{2}\frac{49}{21}$ dir. co.
Gain by the circuitous course, 11 $2\frac{6}{13}\frac{2}{47}$ pr. cnt

(3.) When the course of exchange between Amsterdam and Paris is 1 florin $7\frac{1}{2}$ stivers for 3 francs, and between London and Amsterdam $10\frac{3}{4}$ florins for £1 sterling, what is the proportionate par of exchange between London and Paris?

(4.) A merchant in Hamburgh has to remit to his correspondent in London; the direct exchange is $32\frac{1}{12}$ shillings Flemish; but Hamburgh exchanges with Amsterdam at 18 stivers 12½ pennings for 1 mark banco; whether is it more advantageous for the Hamburgh merchant to remit to London direct or by way of Amsterdam, London exchanging on Amsterdam at 35 schillings 8 grotes per £. sterling?

(5.) A. of Paris has to remit to B. of London, 34475 francs exchange 25 francs 20 cents per £.sterling; but bills on other places can be had on the following terms, viz.—Paris on Hamburgh, 184½ francs for 100 marcs banco; Hamburgh on Vienna, 200 marcs banco for 147 florins; Vienna on Genoa, 118 florins for 300 lire nuove; Genoa on Amsterdam, 2·10 lire for 1 florin; Amsterdam on London, 11·95 florins for £1 sterling; which is the more advantageous, the direct exchange or the circuitous, allowing ½ per cent. commission?

INVOLUTION.

A POWER of any number is that number multiplied by itself a certain number of times. A number, in relation to any power of it, is called the *first* power or root; the *second power or square*, is the product of the number multiplied by itself, and when the square is multiplied by the root, it is called the cube or *third* power; and the third power multiplied by the root gives the fourth power, and so on. Powers of numbers are denoted by a small figure written at the upper corner, on the right of the number called the index or exponent; hence, to raise a given number to any power, multiply the number by itself until the number of factors equal the number of units in the index of the proposed power.

EVOLUTION

IS THE EXTRACTION OF ROOTS.

To Extract the Square Root (sign $\sqrt{}$).

1st, Divide the given number by a comma into periods of two figures each, commencing at the right and pointing to the left in whole numbers, and from the left or decimal point to the right in decimals. Write the square root of the greatest square number contained in the first period to the left, as the first figure of the root, and subtract its square from the first period, annexing to the remainder the next period for a dividend. Double the figure of the root found as part of a divisor, and find how often it is contained in the dividend, omitting the units figure, and annex the figure thus found both to the root and to the divisor. Multiply the divisor thus completed by the figure of the root last found, subtract the product from the dividend, and to the remainder bring down the next period for a new dividend, and for a new divisor add the figure of the root last found, with which proceed as before, and continue the process until all the periods are exhausted. If there be a remainder, annex periods of ciphers, and continue the operation in decimals, until the root is as exact as required. To extract the root of a vulgar fraction, extract separately the root of both of its terms, or extract the root of its equivalent decimal, or multiply the numerator by the denominator, and divide the square root of the product by the denominator. The fourth root is found by extracting the square root of the square root of the given number.

NOTE.—To find a *mean* proportional between two numbers, extract the square root of their product. When one of the angles of a triangle is a right angle, the longest side is called the hypothenuse, and its square is = the *sum* of the squares of the other two sides. The square root of the area of any square is = its side. Circles are proportional to the squares of their circumferences or diameters, and similar plane figures are proportional to their similar sides.

EXAMPLES.

1. Find the square root of 6047·796.

	60,47·79,6 (77·767 + Ans.
	49
147	1147
7	1029
1547	11879
7	10829
15546	105060
6	93276
155527	1178400
7	1088689
155534	89711

2. Find the square root of $\frac{32}{50}$.

$$\sqrt{\tfrac{32}{50}} = \sqrt{\tfrac{16}{25}} = \tfrac{\sqrt{16}}{\sqrt{25}} = \tfrac{4}{5} \text{ Ans.}$$

3. Find the square root of $\frac{2}{3}$

$$\sqrt{\tfrac{2}{3}} = \tfrac{\sqrt{2}}{\sqrt{3}} = \tfrac{\sqrt{(2\times 3)}}{3} = \cdot 8164 + \text{Ans.}$$

Or,

$$\sqrt{\tfrac{2}{3}} = \sqrt{\cdot\dot{6}} = \cdot8{,}164 + \text{Ans.}$$

Exercises.

1. Find the sq. root of 46268279
2. " " 46268·279
3. " " 8342·25
4. " " ·037684
5. " " ·0037684
6. Find the sq. root of ·00000768
7. " " ·0000768
8. " " $\cdot78\dot{4}3\dot{6}$
9. " " $\frac{25}{36}$
10. " " $2\frac{1}{4}$

Application of the Square Root.

11. Find the mean proportional between 4 and 16.
12. Find the mean proportional between 2 and 18.
13. Find the side of a square which shall contain 213444 feet.
14. The content of a garden is 2232 yards 6 feet; find the side of a square equal in surface to it.
15. The area of a circle is 76765625 yards; find the side of a square equal in surface to it.
16. Find the hypothenuse of a right angled triangle, whose other sides are 8 and 6.
17. A spire 200 feet high has a line stretched from it to a point 25 yards from its base; find the length of the line.
18. A line stretched from the top of Melville's Monument to a point 100 feet from its base is 180·5 feet; what is the height of the monument?
19. There are two circular fish-ponds in a gentleman's garden, the diameter of the smaller one is 45 feet, and its surface is half that of the greater one; required the diameter of the greater.

TO EXTRACT THE CUBE ROOT.

Divide the given number into periods of three figures each, counting from the right hand in integers, but from the left in decimals. Find the greatest cube in the left hand period, and write its cube root as the first figure of the root. Subtract its cube from the left hand period, and to the remainder bring down the next period for a dividend. Multiply the square of the part of the root found by 300 for a trial divisor; divide the dividend by it, and write the quotient as the next figure of the root; multiply the former part of the root by 30, and by this new figure for the second part of the divisor, which place under the trial divisor; write the square of the last figure of the root under this second part, and the sum of the three parts will be the complete divisor, which multiply by the last figure of the root, and subtract the product from the dividend, and to the remainder bring down the next period for a new dividend. Proceed in same way, until all the periods are brought down.

EXAMPLE.

Find the cube root of 111215247129.

111,215,247,129 (4809 root.
64

$4^2 \times 300 = 4800$)47215 dividend
$4 \times 30 \times 8 = 960$
$8^2 = 64$

$5824 \times 8 = 46592$

$480^2 \times 300 = 69120000$) 623247129 dividend
$480 \times 30 \times 9 = 129600$
$9^2 = 81$

$69249681 \times 9 = 623247129$

EXERCISES.

1. Find the cube rt. of 52313624
2. " " 640503928
3. " " 105421615424
4. " " 117289217375
5. " " ·017576
6. " " ·049430863
7. " " ·0000039304
8. " " 228608·924
9. Find the cube root of 44·6
10. " " 102832·119125
11. " " 376
12. " " $\frac{8}{50}$
13. " " 8
14. " " $3\frac{3}{8}$
15. " " $\frac{5}{9}$
16. " " $4\frac{1}{6}$

Application of the Cube Root.

NOTE.—Similar solids are to each other as the cubes of their corresponding dimensions—the *surfaces* of globes are to each other as the *squares* of their diameters; but the *content* of a globe is to the *cube* of its diameter, as the content of another globe is to the cube of its diameter.

1. Find the side of a cubical vessel which will hold three times as much as one 9 inches deep.

2. A packing box, 3 feet long, 2 wide, and 1 deep, contains ¾ of the goods we have to pack, find the dimensions of one which will hold the whole of the goods.
3. A farmer's oat chest is 4 feet long, 3⅓ feet broad, and 3½ feet deep, what must be the dimensions of one which shall hold twice as much?
4. An iron ball, 5·04 inches in diameter, weighs 18 lbs., find the diameter of an iron ball weighing 309 lbs.
5. An iron ball, weighing 9 lbs., is 4 inches in diameter, find the weight of an iron ball 2 inches in diameter.
6. The content of a cask, of which the diagonal is 20 inches, is 18 gallons, find the diagonal of a similar cask, which contains 97 gallons.
7. If 37·8125 grains of gold are required to gild a ball which weighs 1331 ounces, how many grains will be required to gild a ball which weighs 512 ounces?

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